ERA-NET NEURON

European Research Projects on Neurodevelopmental Disorders

Joint Transnational Call 2015

Impact Report

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Abbreviations

AKA	Academy of Finland, Finland
ANR	French National Research Agency, France
BMBF	Federal Ministry of Education and Research, Germany
CIHR-INMHA	Canadian Institutes of Health Research – Institute of Neurosciences, Mental Health and Addiction, Canada
CSO-MOH	Chief Scientist Office, Ministry of Health, Israel
ERA-NET	European Research Area Network
FCT	Foundation for Science and Technology, Portugal
FNRS	Fonds de la Recherche Scientifique, Belgium
FRQS	Fonds de recherche du Québec-Santé, Québec, Canada
FWO	Research Foundation – Flanders, Belgium
LAS	Latvian Academy of Sciences, Latvia
JTC	Joint Transnational Call
MINECO	Ministry of Economy and Competitiveness, Spain
MOH	Ministry of Health, Italy
NCBR	National Centre for Research Development, Poland
NEURON	Network of European Funding for Neuroscience Research
RANNIS	The Icelandic Centre for Research, Iceland
SAS	Slovak Academy of Sciences, Slovakia
UEFISCDI	Executive Agency for Higher Education, Research, Development and Innovation Funding

Introduction

ERA-NET NEURON

Public health is a central priority for individuals and governments globally. Worldwide, the WHO estimates one billion people suffer from neurological disorders, with disorders of the brain accounting for 1 in 10 deaths. These disorders are often chronic and incurable, causing significant deleterious impacts on quality of life. It is presently recognised that several neurological and psychiatric disorders e.g. schizophrenia, autism and epilepsy can be originated at early steps of child development, when the nervous system is still immature and highly vulnerable. Developing and translating basic neuroscience research into preventive, diagnostic and therapeutic outcomes for clinical use is a priority for public health policy.

The European community includes a vast pool of scientific and medical expertise. In order to coordinate research objectives and promote European research collaborations, the European Commission developed European Research Area NETworks (ERA-NETs). These ERA-NETs aim to support and encourage cross-border collaboration in various fields of research by supporting joint activities. The Network of European Funding for Neuroscience Research (NEURON; www.neuron-eranet.eu) was initiated in 2003 as a pilot Specific Support Action. It was developed into an ERA-NET in 2007 and has been funded by the European Commission in three phases: NEURON I (2007 – 2011), NEURON II (2012 – 2015) and NEURON Cofund (2016-2020), NEURON Cofund2 (2021-2025). The overarching aim of NEURON is to support the translation of results from fundamental brain research into improved prevention, diagnosis, therapy and rehabilitation for patients, their family, and carers.

Joint Transnational Calls (JTC) for research proposals are the centrepiece of NEURON's transnational activities. On behalf of national ministries and funding organizations, NEURON coordinates an annual launch of a JTC in the field of disease-related neuroscience addressing important issues in fundamental neuroscience, neurology, or psychiatry (see call topics table 1). These funding calls aim to push forward research in strategically identified areas by encouraging transnational and cross-disciplinary projects. The main activity of NEURON is therefore the coordinated, transnational funding of basic, clinical and translational research projects on the nervous system. The NEURON initiative today is the result of the coordinated efforts of 25 funding organisations across 22 countries engaging in a joint effort to promote excellent research in disease-oriented neuroscience.

Table 1: JTCs launched under ERA-NET NEURON

Year	Topic	Impact Report
2008	Neurodegeneration	Published 2014
2009	Method and Technology Development	Published 2015
2010	Mental Disorders	Published 2017
2011	Cerebrovascular Diseases	Published 2017
2012	Method and Technology Development II	Published 2018
2013	Mental Disorders II	Published 2019
2014	Neuroinflammation	Published 2020
2015	Neurodevelopmental Disorders	**Current**
2016	External Insults to the Nervous System	Projects Ongoing
2017	Synaptic Dysfunction	Projects Ongoing
2018	Mental Disorders III	Projects Ongoing
2019	Biomarkers	Projects Ongoing
2020	Sensory Disorders	Projects Ongoing
2021	Neurodevelopmental Disorders	Projects Selected
2022	Cerebrovascular Diseases	Launched

Joint Transnational Call 2015 "European Research Projects on Neurodevelopmental Disorders"

For the 8th NEURON JTC, 16 funding organisations from 14 countries launched a Joint Transnational Call for Research Proposals on 'Neurodevelopmental disorders' (table 2), resulting in a total of 7.7 M€ in funding for ten successful projects (table 3). Insults occurring at critical neurodevelopmental stages have been increasingly identified as important factors in the development of various psychiatric and neurological conditions. The JTC 2015 invited projects including research from basic disease mechanisms up to proof-of-concept clinical studies covering either 1) fundamental research on the pathogenesis and/or aetiology of neurodevelopmental disorders, including the development of innovative or shared resources, and new technologies for the prediction, prevention or therapy of disease or 2) clinical research, including the exploitation of novel clinical data sets, to develop new strategies for diagnosis, therapy, and rehabilitation procedures for diseases in which neurodevelopmental mechanisms play the key role.

Partner Countries	Funding Agencies
Belgium	Research Foundation – Flanders (FWO) Fonds de la Recherche Scientifique (FNRS)
Canada	Canadian Institutes of Health Research – Institute of Neurosciences, Mental Health and Addiction (CIHR-INMHA; FRQS)
France	French National Research Agency (ANR)
Finland	Academy of Finland (AKA)
Germany	Federal Ministry of Education and Research (BMBF)
Iceland	The Icelandic Centre for Research (Rannis)
Israel	Chief Scientist Office, Ministry of Health (CSO-MOH)
Italy	Ministry of Health (MOH
Latvia	Latvian Academy of Sciences (LAS)
Poland	National Centre for Research and Development (NCBR)
Portugal	Foundation for Science and Technology (FCT)
Romania	Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)
Slovakia	Slovak Academy of Sciences (SAS)
Spain	Ministry of Economy and Competitiveness (MINECO)

Table 2: Funding Organisations participating in JTC 2015

The selection of research projects was completed in two peer-reviewed stages by a pool of 56 international experts. In the first step, 98 consortia composed by 365 research groups submitted pre-proposals, each evaluated by 3 expert reviewers. Of these, 35 consortia were invited to submit a full proposal, that was again evaluated by expert reviewers before the final ranking was made by a 14-member peer-review panel and 6 external reviewers.

Projects were evaluated using the following criteria:

1. Relevance to the aim(s) of the call
2. Scientific quality of the proposal (innovation potential, methodology)
3. Feasibility of the project (adequacy of project work plan and related risk analysis, budgetary and other resources, time schedule)
4. International competitiveness of participating research groups in the field(s) of the proposal (previous work in the field, expertise of the research groups)
5. Quality of collaborative interaction between the groups, and the added value, from both scientific and transnational perspectives, of the research consortium. Consortia not meeting these criteria will be downgraded.
6. Potential of the expected results for future clinical and other health relevant applications.

Ten projects including 43 research groups were selected for funding, with funding provided by national agencies in 8 countries. The selected projects covered a wide range of topics, from basic research to unravel pathophysiological mechanisms to studies designed to treat a wide variety of neurodevelopmental disorders including Autism Spectrum Disorder, Epilepsy, Microcephaly, Schizophrenia, Neurodevelopmental sensory disorders and intellectual disability (table 3).

The projects used a large variety of methodologies and experimental models including transgenic mice models and induced pluripotent stem cell (iPSC) lines, triple electrode electroporation in utero, *In vitro* human cerebral organoids, human 2D and 3D cell models, gene sequencing and omics approaches among other techniques.

The projects were completed between November 2015 and May 2021.

Acronym	Proposal Title	Coordinator (in bold) and partners	Country (Agency)	Pathology
AUTISYN	Modelling syndromic autism caused by mutations in the ADNP gene	**Frank Kooy**	**Belgium (FWO)**	Autism Spectrum Disorders
		Illana Gozes	Israel (CSO-MOH)	
		Germain Pierre Luc	Italy (MOH)	
		Christopher Pearson	Canada (CIHR)	
ChromISyn	Chromatin-related intellectual disability syndromes: Molecular etiology and therapy	**Angel Barco**	**Spain (MINECO)**	Intellectual disability
		Lidia Larizza	Italy (MOH)	
		Efrat Edry	Israel (CSO-MOH)	
		Eloisa Herrera	Spain (MINECO)	
DeCipher	Deciphering hyperexcitable networks associated with neurodevelopmental lesions	**Albert J. Becker**	**Germany (BMBF)**	Epilepsy
		Alfonso Represa	France (ANR)	
		Ilan Lampl	Israel (CSO-MOH)	
		Heinz Beck	Germany, BMBF	
		Viktor Jirsa	France (ANR)	
ImprVision	Understanding and reprogramming developmental visual disorders: from anophthalmia to cortical impairment	**Paola Bovolenta**	**Spain (MINECO)**	Sensory Disorders
		Benedikt Berninger	Germany (BMBF)	
		Carolina Frassoni	Italy (MOH)	
		Michéle Studer	France (ANR)	
		Marta Nieto	Spain (MINECO)	
MicroKin	Deciphering the multifaceted pathways underlying MCPH pathogenesis in the mouse and human	**Pierre Gressens**	**France (ANR)**	Microcephaly
		Pierre Vanderhaeghen	Belgium (FNRS)	
		Marcos Malumbres	Spain (MINECO)	
		Wieland Huttner	Germany (BMBF)	
Neuro-DREAM	Neuro-Developmental Research on the Etiology of Amblyopia and its Management	**Jochen Triesch**	**Germany (BMBF)**	Sensory Disorders
		Robert Hess	Canada (FRQS)	
		Concetta Morrone	Italy (MOH)	
		Maria Fronius	Germany (BMBF)	
RESPOND	Role of serotonin in the pathogenesis of neurodevelopmental disorders	**Michael Bader**	**Germany (BMBF)**	Attention-deficit, Autism Spectrum Disorders
		Klaus Lesch	Germany (BMBF)	
		Piotr Popik	Poland (NCBR)	
		Patricia Gaspar	France (ANR)	
SMART	Striatal development and Meis1 Action in Restless Legs Syndrome	**Juliane Winkelmann**	**Germany (BMBF)**	Restless legs syndrome
		Miguel Torres	Spain (MINECO)	
		Wojciech Krezel	France (ANR)	
STEM-MCD	Stem cells and mechanisms contributing to human cortical malformations	**Fiona Francis**	**France (ANR)**	Cortical malformations
		Orly Reiner	Israel (CSO-MOH)	
		Laurent Nguyen	Belgium (FNRS)	
		Nadia Bahi-Buisson	France (ANR)	
		Julia Ladewig	Germany (BMBF)	
SynPathy	Key Determinants of Synaptic Excitation/Inhibition Imbalance in Autism Spectrum Disorders - From Genetic Animal Models to Human Patients	**Joris de Wit**	**Belgium (FWO)**	Autism Spectrum Disorders, Schizophrenia
		Ann Marie Craig	Canada (CIHR)	
		Nils Brose	Germany (BMBF)	
		Daniel Choquet	France (ANR)	
		Thomas Bourgeron	France (ANR)	

Table 3: JTC 2015 Funded Projects and Consortia

Key Performance Indicators

As part of the final report for each project, researchers were asked to fill out a questionnaire (see Annex II) to measure the key performance indicators set by NEURON (table 4). A summary of the different aspects evaluated by this questionnaire is described below and organised according to the overarching objectives of the ERA-NET NEURON.

Objective of the Funding Programme	Key performance indicators	Measures (i.e. items in the questionnaire)
1. Enhance excellent cooperation between scientists working in the field of neuroscience	Communication of results	List of publications and communications - level of co publication, bibliometric indicators. (**Question 1.2**)
	NEURON JTC as starter of new collaborations	Have the partners participating in the NEURON project collaborated before applying for the NEURON JTC2015? (**Question 3.1**)
	New research groups from other countries joining the consortium	During the life time of the project has the consortium established collaboration(s) with other teams (not already participating in the JTC 2015 project)? (**Question 3.2**)
	Sustainability of the collaboration (obtaining further funding for the same consortium)	Have the results led to new initiatives in other types of funding programmes? (**Question 3.3**)
	Intensity of collaboration, early researcher participation (mobility)	List of meetings, young researchers involved in the project, lab visits/exchange of researchers, and training within the consortium (**Question 3.4**)
2. Promote multi-disciplinary consortia and to encourage translational research proposals (from bench to bedside)	Consortium Composition	List of research groups
	Patient Involvement	patients/patient representatives involved in planning and/or conducting the research project? (**Question 6**)
	Patents and other outcomes with public health impacts	Patents and other outcomes with impact to health (**Question 2**)
3. Support the development of innovative or shared resources and technologies	Evaluation of the development and the use of new resources	Has the consortium created a new or further developed an existing transnational patient registry, database or biobank? Have the consortium partners exchanged biomaterials (DNA, tissues, cells, animals)? Including data management (**Questions 4 and 2**)
4. Support research to develop new strategies for diagnosis, therapy, and rehabilitation procedures	Evaluation of the development of new strategies for diagnosis, therapy, and rehabilitation procedures for neurodevelopmental disorders.	Have the results of the NEURON research projects allowed the development of new strategies for: diagnosis, therapy (preparation of clinical trials), and rehabilitation procedures for neurodevelopmental disorders, prevention or anything else? (**Question 5.1**)
	Major achievements	Please list the major achievement of the consortium. (**Question 5.2**)

Table 4: Key performance indicators in relation to the objectives of the funding programme (The number of the respective question in the questionnaire is given in brackets)

Objective of the Funding Programme	Key performance indicators	Results (percent of funded consortia, if not specified).
1. Enhance cooperation between European scientists working in the field of neuroscience	NEURON JTC as starter of new collaboration	→ 90% were newly formed consortia → 10% pre-existing consortia (part of PIs collaborated before) → 0% pre-existing consortia (all PIs collaborated before)
	New research groups from other countries joining the consortium	→ 90% acquired new collaborations during the lifetime of the project.
	Sustainability of the collaboration (obtaining further funding for the same consortium)	→ 60% had at least 2 PIs applying jointly for further funding
	Intensity of collaboration (meetings, mobility, joint publications)	→ 100% attended the mid-term symposium → Each consortium held a median of five meetings; 74% of the meetings were attended by all partners →~14% of all publications were published jointly in peer-reviewed journals
	Level of excellence of the funded research	→ 70% published at least one primary research publication in a peer-reviewed journal with an Impact Factor above 10
2. Promote multidisciplinary consortia and to encourage translational research proposals (from bench to beside)	Composition of the consortium	→ In 30% the consortium coordinator was a medical doctor. → In 70% at least one PI was a medical doctor. → PIs worked in basic (95% of PIs) and clinical (2% of PIs) research labs and 2% in hospitals
	Involvement of patients	→ Patients were involved in 40% of the projects.
	Patents and other outcomes with impact to health	→ 50% submitted at least one European or international patent or produced outcomes with impact to health including the launch of services, diagnostic or therapeutic tools
3. Support development of innovative or shared resources and technologies	Development and the use of new resources	→ 90% exchanged biomaterials and data (DNA: 60%, tissues: 70%, cells: 70%, animals: 60%, clinical data: 30%)
4. Support research to develop new strategies for diagnosis, therapy, and rehabilitation procedures	Development of new strategies	→ 30% developed new strategies for diagnosis → 40% developed new strategies for therapy
	Major achievements	→ The major achievements that were most frequently reported include: novel model systems (100%), biomarkers (30%), and development of innovative therapies (40%)

Table 5: Summary of major achievements in the frame of key performance indicators

In the following sections, the analysis shows the outcomes of the funded projects in the context of NEURON objectives, summarized in table 5. In addition to the indicators used for this analysis,

NEURON constantly monitors the progress of the funded research projects through annual and final reports summarizing the most important scientific results and consortium achievements. On the other hand, coordinators of the funded projects are invited to present interim results at a mid-term symposium, subjected to evaluation.

This continuous interaction between the consortia coordinators and the call secretariat was established from the beginning ensuring the appropriate development and completion of the planned work.

Objectives of the Funding Programme

1. Enhance excellent cooperation between scientists working in neuroscience

Communication of funded research results

Consortium partners were asked to report the dissemination channels of project results. This included peer-reviewed publications (journal articles, reviews, and books or book chapters), PhD dissertations, presentations (written and oral) to scientific congress, and articles dedicated to the public (table 6). Peer reviewed articles and reviews were included only if NEURON support was acknowledged. Table 6 presents a summary of the different communications produced by the funded consortia.

Type of publication	Total	Consortia (total)
Peer-reviewed articles (including reviews)	**205**	10
Reviews	52	8
Books or book chapters	2	2
Communications in scientific congresses	~200	9
PhD Dissertations	13	6

Table 6: Total publications resulting from projects funded through JTC 2015

All the consortia declared mainly peer-reviewed publications at the end of the projects at a rate corresponding to a median value of 14 articles per consortia. More than 86 percent of the publications (including books) were authored by a single consortium member while 9 consortia published articles authored by at least 2 consortium members (Fig. 1a). Further publications are expected in the years to

come since at least 15 new publications were in preparation by eight consortia at the time of the final report.

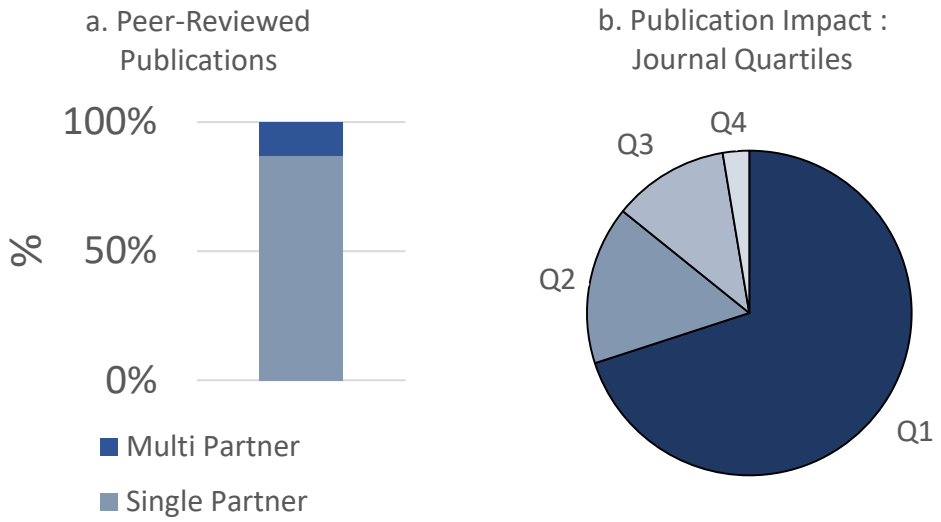

Figure 1: Peer-reviewed publications. a) Proportion of multi- and single-partner peer-reviewed articles published by the 10 funded consortia. b) Distribution of peer-reviewed publications by quartile rank indexed in relevant disciplines associated to the neurosciences in the Web of Sciences (Q).

Web of Sciences (WoS) was used to categorise the publications in scientific domains. The fields of Neurosciences, Psychiatry or Neurology were taken as principal references for the analysis (Figure 1b and 2). The publications were less prominently indexed in other relevant fields such as genetics, developmental biology/anatomy, cell and molecular biology, medicine, ophthalmology, engineering and multidisciplinary sciences (Figure 2); these categories were considered for the analysis when the publications were not indexed in the neurosciences or the neurology fields.
Almost 80 percent of the peer-reviewed publications excluding books were published in high impact journals (1st or 2nd quartile taking neurosciences or neurology as main references in the WoS-; Figure 1b).

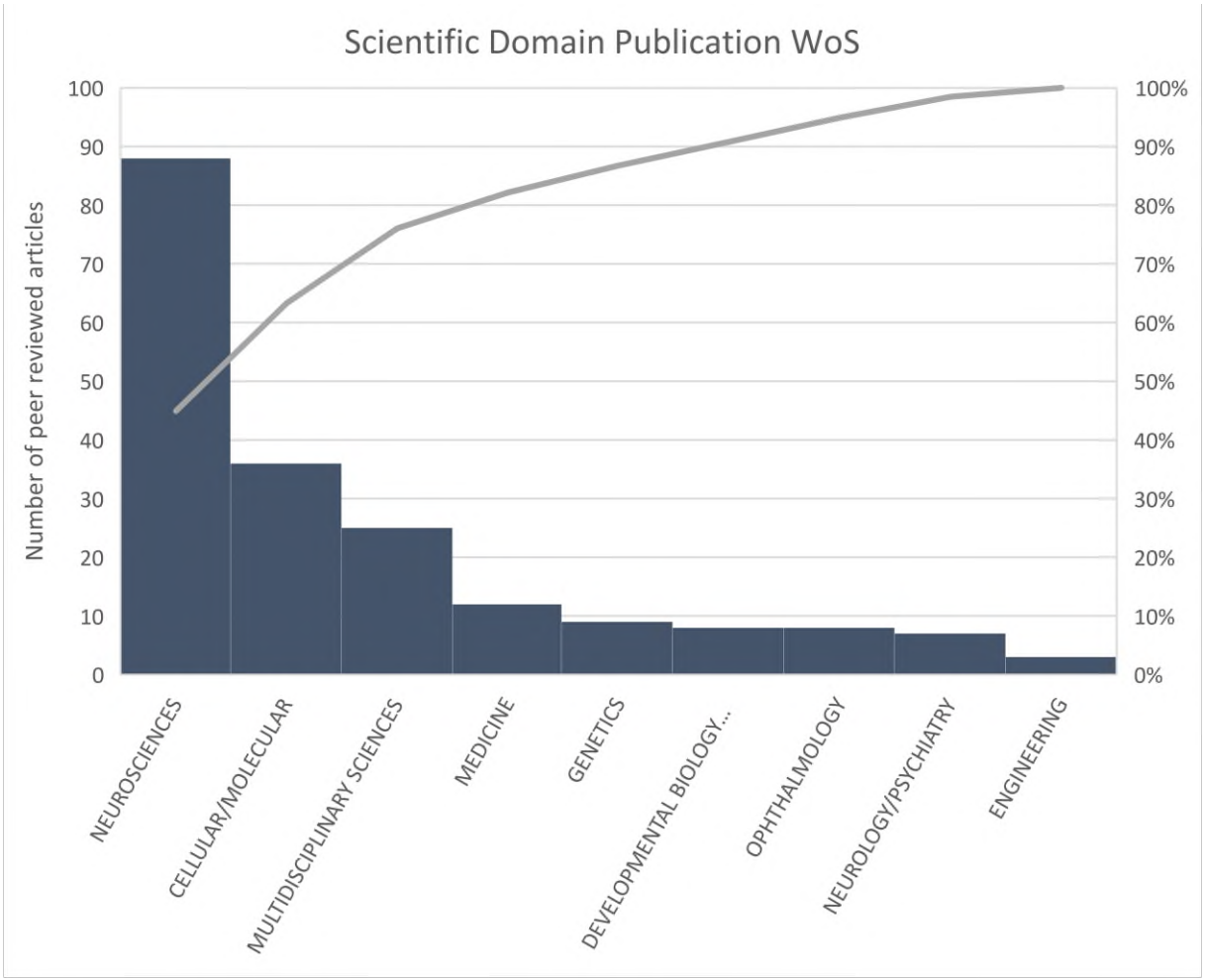

Figure 2: Peer-reviewed publications main scientific domain according to the WoS. The picture depicts the main disciplines to which the publications produced by consortia funded in JTC 2015 contributed.

NEURON JTC as a starter of new collaborations

The questionnaire contained a series of questions on the structure of the consortia, including whether the partners had previously collaborated on a research project and whether new collaborations arose or will continue during and after the funding period. The results are summarised below.

Nine out of the ten funded consortia included members with a history of collaboration before this ERA-NET NEURON project; in general, the coordinators have collaborated with at least one other partner. In four consortia, other partners had as well previously collaborated. The consortia grew then by addition of new partners. None of the funded consortia had worked together as a full group before the present call.

New research groups from other countries joining the consortium

Nine consortia reported twenty-seven new collaborations with individual international research groups, mainly European but also groups working in Japan, Australia, Canada, Russia, and Israel. These collaborations were established to further explore aspects related to the initial project.

Sustainability of the collaboration

Researchers were asked to report follow-on collaborations including further funding applications by consortia members. This measure indicates the impact of consortium development, both in continuing to advance projects beyond the ERA-NET funding period, and the ongoing value of the academic collaboration.

Members of four funded consortia applied for five grants in their national context. Moreover, six consortia submitted an international funding request each, these include two ERA-NET NEURON proposals, and two H2020 grants (one for a training network) as well as a European Cooperation in Science and Technology (COST) action. At least one other consortium was considering applying for European grants.

It is thus likely that the projects initiated in the framework of JTC 2015 will be further developed. The new funding might sustain the international collaborations for a period outlasting JTC 2015.

Intensity of Collaboration

Consortia are encouraged to organise regular in-person or virtual meetings and staff exchanges to take full advantage of the range of expertise of project partners and to develop the skillsets of individual lab members. All the consortia organised between 2 and 8 meetings (median of 5; total 45) attended by the whole consortium and some other bilateral meetings (total 16). These meetings were considered fruitful to allow the exchange of scientific ideas and plan for funded and future work. In mature phases of the project some consortia extended the participation of other collaborators in these meetings, either to members of the consortium labs non-initially involved in the project (in particular early career researchers) or even to other ERA-NET NEURON funded consortia.

A total of 23 members of staff involved in eight projects; mainly early career researchers - master and PhD students or postdocs and technicians - visited the partner labs to learn new techniques and exchange experience. On top of the exchange of techniques these visits allowed networking and encouraged further collaborations. At least five postdocs in the funded consortia were establishing new independent laboratories during the funding period. The meetings allowed the establishment of long-lasting collaborations for these newly established principal investigators. The exchange in meetings and the ERA-NET funding was considered instrumental for two former postdocs to get a permanent position, one in the institution of a consortium partner. Seven early career researchers in three consortia received prizes for their work mainly at conferences but as well the Boehringer-Ingelheim Prize for excellent postdocs and junior group leaders.

A Midterm Symposium was organised by NEURON in Riga in 2017. A consortium member, the coordinator in general, gave a presentation on the consortium work progress. Two former reviewers evaluated the progress and the coordinators received feedback. Two main aspects were evaluated: scientific progress (outcomes produced/advancement of the workplan) and collaboration between the partners. In general, the evaluations were satisfactory since most work packages were on time by the midterm symposium and some projects started publishing their results. The event allowed interaction between researchers in the same field and funders. The early career researchers could as well show their work to experts from other consortia.

Summary

The present analysis shows that ERA-NET NEURON funding resulted in a high number of interactions between research groups in several countries. Most of these interactions were established for the first time within the consortia and were extended towards new groups throughout the development of the project. As a highlight, the present funding was instrumental for a handful of newly established

researchers to get long lasting collaborations and networking as well as for numerous PhD students to get their degrees.
Most of the collaborations outlast the period of funding by the ERA-NET NEURON as evidenced by the report on new multi-partner publications still in preparation at the end of the project, as well as by the ongoing follow up work reported, which is at the origin of national and international applications for funding.
All consortia were very active and produced diverse and numerous publications with high relevance mainly in the field of neurosciences but also contributed publications in generalist journals and journals specialised in other basic research fields such as genetics, developmental biology but also engineering or medical disciplines, as expected considering the scope of the call on neurodevelopment.

2. Promoting multi-disciplinary consortia and translational research proposals (from bench to bedside)

Consortium composition

The ERA-NET NEURON aims to promote the interdisciplinary collaboration to solve unmet medical needs in the field of nervous system disorders, through the development of translational research projects. As such it is expected that the consortia include expertise from basic academia but also any other expertise needed to pave the way towards solutions for the diseases occurring during nervous system development. Out of the 43 researchers,11 were medical doctors represented in seven out of the ten funded consortia, three of them as coordinators.

The researchers involved in the projects work at basic and clinical research laboratories and for this topic only one researcher works at a hospital as well.

Other than the researchers having applied for ERA-NET NEURON funding, the projects included other staff in the labs where the work was developed. Postdoctoral researchers and master, medical or PhD students, some of them funded by NEURON, represent the main category of staff in the projects (53 postdocs and 59 student). Some other staff categories such as technicians, associated researchers or Engineers (respectively 9, 2, 2) were also reported as being involved in the projects (Figure 3).

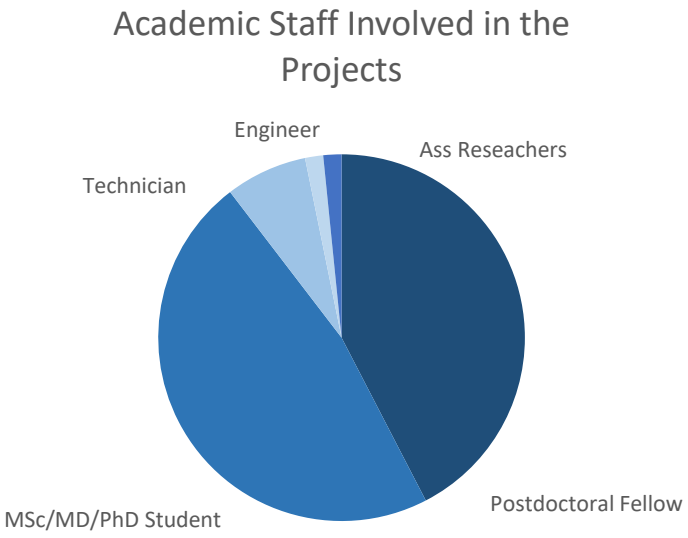

Figure 3: Staff participating in the funded projects

Patient involvement

Researchers were asked to report the involvement of patients or patient groups as active members of the project. This includes involvement in the design, coordination (as part of a committee or advisory board), analysis or interpretation of research data, or in the dissemination of results.

Four of the projects involved patients or patient representatives at different degrees; three of them participated to dissemination events organised by patient representatives. One consortium broadcast a seminar describing their results to lay audience and established interactions with patients' organisations to get feedback on research priorities concerning the specific disease under study and established long term cooperation as advisors for a patient organisation in USA. Two other consortia declared considering the involvement of patients for future studies. The call text did not particularly encourage the participation of patients in the projects.

Patents and other outcomes with public health impacts

The consortia generated products and knowledge with potential impact for public health and further development of the research in the field, the main examples are described below.

A consortium filed an international patent for a pharmacological compound with potential to be used in the prevention of neurodevelopmental disorders. Moreover, antibodies against a homeobox protein involved in the development of several organs including the nervous system were licenced and presently commercialized by Millipore and another antibody against a protein implicated in psychiatric disorders is commercialised by Synaptic Systems.

Three projects generated new diagnostic tools with potential value for clinical use in developmental visual deficits, sleep disorders and cortical malformation. Moreover, a project produced iPSCs with the potential to be used as a platform for drug testing.

At the preclinical level, most projects provided information concerning the pathophysiological mechanisms responsible for various neurodevelopmental diseases and identified proteins or genetic components of relevance for these diseases. Two projects proposed pharmacological therapeutic approaches based on elucidated pathophysiological mechanisms for epilepsy and attention deficit hyperactivity disorder (ADHD).

Two consortia launched shared platforms or expert networks to share genetic, clinical and research information on brain malformations and a specific genetic mutation involved in neurodevelopmental disorders. Data was contributed to a patient registry on cortical malformations.

Summary

The ERA-NET NEURON encourages the research groups to fill the gap between basic and clinical research towards translation and to develop research with potential to transform into solutions to be used for the diagnosis and treatment of brain diseases. The consortia funded in the frame of JTC 2015 included at least 25 percent of medical doctors collaborating with basic researchers and involving more than one hundred early career researchers. Several outcomes with potential value for clinical use on various diseases were developed mainly at the preclinical level. The main outcomes of the projects were the identification of pathophysiological processes or genetic determinants involved in neurodevelopmental diseases, some of them leading to propose putative therapeutic approaches. Most of these contributions will continue being developed after the end of these projects. Even if human data or tissue was used in most of the projects, less than half of them implicated patients on the planning or design but generated broad dissemination material and established contacts with relevant patient representatives. The role of patients as active contributors in research is increasingly important and several of the projects consider involving patients at more advanced stages of their studies.

3. Supporting the development of innovative or shared resources and technologies

Development and the use of new resources

The consortia generated a series of resources shared among the partners of a project or open to broader scientific, clinical, and other relevant communities. All ten projects produced new experimental models: mainly *in vitro* models such as iPSCs, *in sillico models,* and at least 16 new mice models; most of them exchanged among partners (Figure 4).

Five consortia generated shared clinical or experimental databases and platforms offering tools for research: some of them open to the wider community. Others exchanged genetic material, tissue, reagents etc.

Six consortia generated clinical, genetic or omics datasets which were fed into public databases and at least one contributed iPSCs models to public registries.

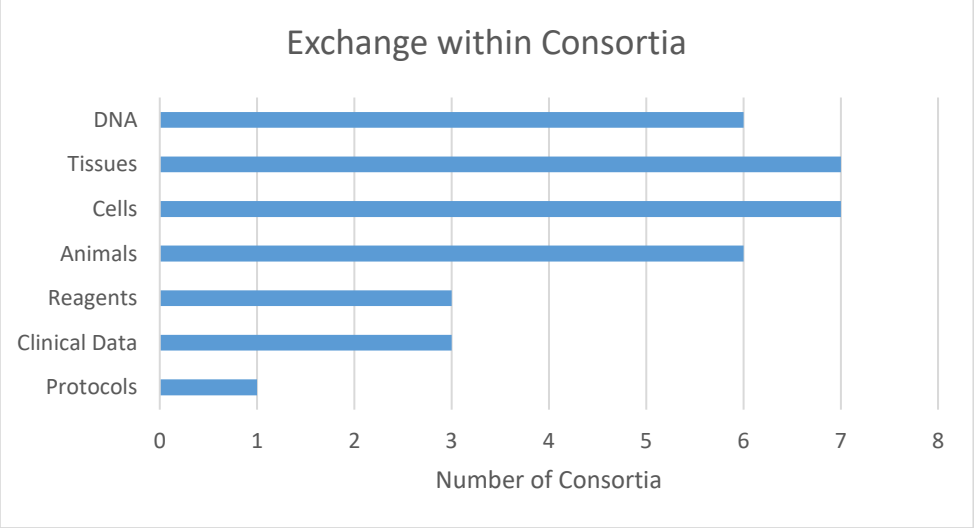

Figure 4: Exchange of resources among consortia members

Summary

The ERA-NET NEURON aims to support the development of new tools and resources available to the research and clinical community at large. The funded consortia generated relevant experimental models for several neurodevelopmental diseases as well as datasets which were exchanged between the participating laboratories and made available to the research community. The resources generated within ERA-NET NEURON funding are expected then to be further exploited to produce new knowledge on the brain disease field.

4. Supporting research to develop new strategies for diagnosis, therapy, and rehabilitation

Development of new strategies for diagnosis, therapy, and rehabilitation procedures for neurodevelopmental diseases

All the consortia concentrated their work on the identification of pathophysiological mechanisms in the context of the following neurodevelopmental diseases.

- Autistic spectrum disorder.
- Epilepsies and intellectual disabilities associated to brain malformations.
- Psychiatric conditions such as Attention-deficit hyperactivity disorders and Schizophrenia.
- Neurodevelopmental visual disorders.
- Restless legs syndrome.

Four projects developed novel therapeutic approaches, based on the knowledge of pathophysiological mechanisms, using the following strategies:

- Repurposing of drugs with effects on epileptic seizures.
- Use of drugs to prevent/rescue cortical malformations.
- Human cellular reprogramming to correct visual impairments.
- Physical activity and visual learning to improve amblyopia and test of efficacy of therapies based on visual deprivation under the light of plasticity measurements.

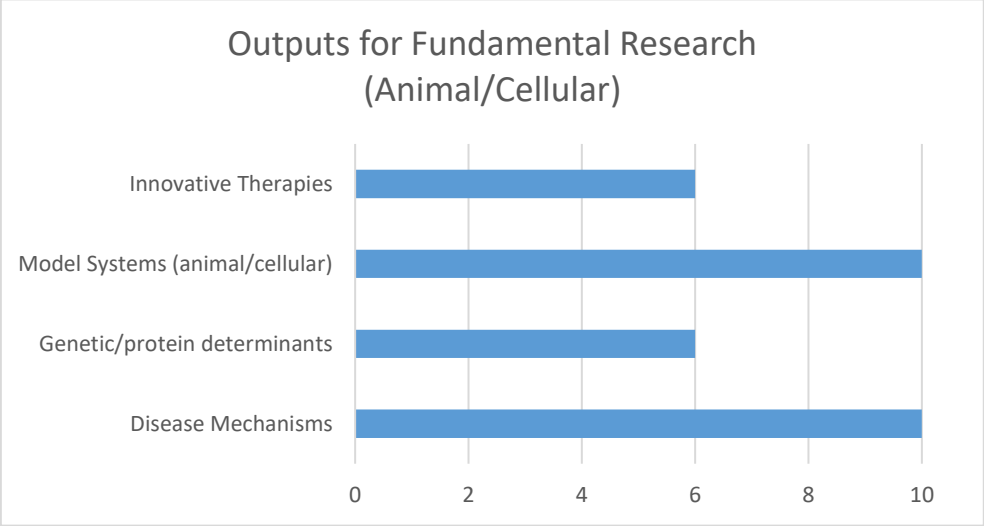

Figure 5: Output contributions for further research by consortia

.Major achievements of the research consortia

As detailed in previous sections and in agreement with the general objectives of this call the project outcomes were mainly concentrated on the study of the pathogenesis or aetiology of neurodevelopmental disorders and the development or improvement of therapeutic approaches mainly at the preclinical level.

Most of the consortia highlighted the importance of the early career researchers' participation on the funded projects. For several among them, the ERANET NEURON funding was instrumental for the advancement of their careers whether to get PhD degrees, permanent positions and long-lasting collaborative networks.

Further multinational collaborations initiated in the context of this funding initiative continued after the end of the projects. At least two large and long-lasting expert networks were established and include researchers funded through JTC 2015.

Summary

In agreement with the general objectives of this call, the funded projects produced knowledge and tools to address diverse brain diseases originated early in development. The contributions span to a large variety of conditions and led to new research paths at preclinical and clinical levels. The continuation of the collaborations will result in new studies to validate the clinical value of the approaches and findings. Important links were established among researchers within and outside the funded consortia but also with other academic, industrial, and large public stakeholders such as patient organisations likely leading to increase the value of the scientific outputs and accelerate the research on brain diseases.

General Summary

All in all, the projects funded within JTC 2015 produced high quality and outstanding results to elucidate the pathophysiological mechanisms of a vast diversity of neurodevelopmental diseases. In half of the cases, therapeutic or diagnostic approaches with potential value in the clinical practice were proposed based in newly acquired knowledge.

The projects generated high quality research tools which remain available and frequently open to an extended research community.

Moreover, the collaboration engaged during the funding period of ERANET NEURON JTC 2015 allowed early career researchers to develop their networks and was considered instrumental for career advancement. Thus, the ERA-NET NEURON has contributed to the development of a new generation of researchers with expertise in neurodevelopmental diseases.

Call for Proposals for

‘European Research Projects on Neurodevelopmental Disorders’

Submission deadline for pre-proposals: March 09, 2015, 14:00 CET

Electronic proposal submission

For further information, please visit us on the web

http://www.neuron-eranet.eu

or contact

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1. Purpose

Maintenance, improvement and restoration of human health are of fundamental importance and worldwide priority. Biomedical and health research provide an important basis for the improvement of healthy living. Disorders of the brain are major causes of morbidity, mortality and impaired quality of life. Around one billion people suffer from disorders of the central nervous system. In Europe, disorders of the brain account for approximately one-third of the burden of all diseases. Therefore, neuroscience research and its translation into diagnostic and therapeutic outcomes are fundamental.

To address this, the 'Network of European Funding for Neuroscience Research' (NEURON) has been established under the ERA-NET scheme of the European Commission (http://www.neuron-eranet.eu). The aim of the ERA-NET NEURON is to co-ordinate research efforts and funding programmes of its partner countries in the field of disease related neuroscience.

Under the umbrella of NEURON, seven transnational joint calls have been launched on different topics from 2008 to 2014. The current joint transnational call (JTC-8) is now launched in the field of neurodevelopmental disorders. The following funding organizations have agreed to fund the joint call for multinational research projects in this scientific area. The call will be conducted simultaneously by the funding organizations in their respective countries and co-ordinated centrally by the Joint Call Secretariat.

- Fonds de la Recherche Scientifique (FNRS), Belgium
- Research Foundation Flanders (FWO), Belgium
- Canadian Institutes of Health Research – Institute of Neurosciences, Mental Health and Addiction (CIHR-INMHA), Canada
- Fonds de recherche du Québec-Santé (FRQS), Québec (Canada)
- Academy of Finland (AKA), Finland
- French National Research Agency (ANR), France
- Federal Ministry of Education and Research (BMBF), Germany
- The Icelandic Centre for Research (RANNIS), Iceland
- Chief Scientist Office, Ministry of Health (CSO-MOH), Israel
- Ministry of Health (MOH), Italy
- Latvian Academy of Sciences (LAS), Latvia
- National Centre for Research and Development (NCBR), Poland
- Foundation for Science and Technology (FCT), Portugal
- Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Romania
- Slovak Academy of Sciences (SAS), Slovakia
- Ministry of Economy and Competitiveness (MINECO), Spain

2. Aim of the call

The aim of the call is to facilitate multinational, collaborative research projects that will address important questions relating to the neurodevelopmental nature of neurological and psychiatric disorders. The call will accept proposals ranging from understanding basic mechanisms of disease through proof-of-concept clinical studies in humans. These may include - without excluding others - diseases such as autism, schizophrenia, mental retardation, attention deficit disorders, foetal alcohol syndrome, epilepsy syndromes, cerebral palsy, inherited peripheral neuropathies, sensory disorders and spastic paraplegias. **Disorders that manifest only with neurodegenerative features during adulthood will not be eligible for this call.**

The ERA-NET NEURON funding organizations particularly wish to promote **multi-disciplinary work** and to encourage **translational research proposals** that combine basic and clinical approaches.

Research proposals should cover at least one of the following areas:

a) Fundamental research on the pathogenesis and/or aetiology of neurodevelopmental disorders. This may include the development of innovative or shared resources, and new technologies for the prediction, prevention or therapy of disease.

b) Clinical research, including the exploitation of novel clinical data sets, to develop new strategies for diagnosis, therapy, and rehabilitation procedures for diseases in which neurodevelopmental mechanisms play the key role.

The individual components of joint applications should be complementary and contain novel, ambitious ideas to answer key questions or lead to a step-wise change in understanding. There should be a clear added value in funding the collaboration over the individual projects.

Clinical studies up to the point of proof of concept are eligible for funding[1].

3. Application

3.1 Eligibility

Joint transnational research proposals may be submitted by research teams working in universities (or other higher education institutions), non-university public research institutes, hospitals, as well as in commercial companies, particularly small and medium-size enterprises. The eligibility of the afore-mentioned institutions, together with details of eligible costs (e.g. personnel, material, consumables, travel money, investments), are subject to the administrative requirements of individual funding organizations and will therefore differ. Please note that, for some funding organizations, commercial companies are not eligible or are only eligible under certain conditions (e.g. only in

[1] Eligibility and funding requirements for clinical trials vary between the partner countries. Clarification may be obtained from the individual funding agencies.

partnership with academic institutions in the consortium). Clarification should be obtained from the individual funding agencies (see contact details below).

Only transnational projects will be funded. Each consortium submitting a proposal must be comprised of a minimum of three research groups eligible for funding by organizations listed in this call text (see above); all three groups must be from different countries. The total number of research groups in a consortium must not exceed five. Not more than two research groups can be from the same country.

Research groups not eligible to their national funding organizations or from countries which are not involved in this call may participate in projects only if their participation clearly provides an added value to the consortium and if they present evidence on secured budget for their part in the project. In any case, the total number of research groups in one consortium must not exceed five.

Each consortium should have the critical mass to achieve ambitious scientific goals and **should clearly demonstrate added value** from working together. Each project must nominate a project co-ordinator who represents the consortium externally and is responsible for its internal management (e.g. the application procedure, the consortium agreement, reporting). It is obligatory that the co-ordinator of a consortium is eligible to be funded by one of the organizations listed in this call text.

Although applications must be submitted jointly by groups from several countries, the individual research groups will be funded by the individual NEURON funding organization(s) of their respective countries. Eligibility criteria are the matter of individual partner funding organizations.

Therefore, applicants are strongly advised to follow the instructions contained in the country-specific eligibility tables which are published on the NEURON web site and to contact their national/regional funding organization to confirm eligibility matters before submitting an application.

3.2 Submission of joint transnational proposals

There will be a **two-stage procedure** for joint applications: **pre-proposals** and **full proposals**. In both cases, one joint **proposal document** (in English) shall be prepared by the partners of a joint transnational proposal, and must be submitted to the Joint Call Secretariat by one spokesperson, the co-ordinator.
Pre-proposals must be submitted in electronic format no later than **March 09, 2015** (14:00:00 CET) via the **electronic submission** system.

NOTE: Full proposals will only be accepted from those applicants **explicitly invited** by the Joint Call Secretariat to submit them.

3.3 Further information

For further details, please refer to the respective submission forms available through the NEURON web site. If you need additional information, please contact the Joint Call Secretariat, or your funding organization representative (see Annex for contact data).

4. Evaluation and decision

The review process will be in two stages.

4.1 Formal check of proposals

The Joint Call Secretariat will assess proposals to ensure that they meet the call's formal criteria (e.g. date of submission; number of participating countries; inclusion of all necessary information in English). The Joint Call Secretariat will also forward the proposals to the national/regional funding organizations, which will perform a formal check of compliance with their respective regulations. Proposals not meeting the formal criteria will be rejected at this stage.

The Call Steering Committee may reject proposals if they are clearly outside the scope of the call.

Proposals passing these check points will be forwarded to the joint Peer Review Panel for evaluation.

4.2 Peer-review of proposals

The reviewers will carry out the evaluation according to specific evaluation criteria:

1. Relevance to the aim(s) of the call
2. Scientific quality of the proposal (innovation potential, methodology)
3. Feasibility of the project (adequacy of project work plan and related risk analysis, budgetary and other resources, time schedule)
4. International competitiveness of participating research groups in the field(s) of the proposal (previous work in the field, expertise of the research groups)
5. Quality of collaborative interaction between the groups, and added value, from both scientific and transnational perspectives, of the research consortium.
6. Potential of the expected results for future clinical and other health relevant applications.

4.3 Decision

4.3.1 Pre-proposals

Eligible pre-proposals will be reviewed via a written (remote) peer review process. Based on the scores in the written reviews a ranking list will be set up. By mid May 2015, the co-ordinators of the top proposals will be invited by the Joint Call Secretariat to submit a full proposal **no later than June 23, 2015, 14:00 CET**.

4.3.2 Full proposals

The international Peer Review Panel will establish a ranking list of the fundable proposals by scientific assessment. Based on this ranking list the Call Steering Committee will determine the projects to be funded, taking into account the national budgets available. These recommendations will inform the final decisions which will be made by the funding agencies and will be subject to budgetary considerations.

5. Funding procedure / Responsibilities / Reporting requirements

5.1 Funding procedure

Projects can be funded for a period of up to three years and according to funding organizations' regulations. Funding is expected to start **early in 2016**.

Successful research groups will be funded directly by the respective funding organizations.

Funding will be administered according to the terms and conditions of the responsible funding organizations, taking into account all other applicable regulations and legal requirements.

5.2 Responsibilities

Within a joint proposal, each group leader will be the contact person for the relevant national/regional funding organization. The co-ordinators of funded projects together with the respective funding organizations shall make every effort to seek a common start date for all research groups in the consortium.

After the evaluation and selection procedures are completed, each consortium selected to be funded is required to draft and sign a Consortium Agreement (CA) suitable to their own team. The CA will agree a common project start date, manage the delivery of project activities, finances and intellectual property rights (IPR), and avoid disputes which might be detrimental to the completion of the project. All consortia are strongly encouraged to sign the CA before the official project start date, the CA must be signed within the first six months after the project start date.

5.3 Reporting Requirements

On behalf of the research consortium, the project co-ordinator will be required to submit a brief annual scientific progress report on the project and one final report in the end, to the Joint Call Secretariat. Group leaders may be required to submit reports separately to their national funding organization; reporting guidance will be forwarded by the relevant funding organization, as applicable.

Annual reports should be submitted by April-30 the following year. Annual reports do not need to be submitted if the project ends in the first three months of the following year (i.e. between January and March). In this case, the submission of a final report will suffice. However, instead of submitting the final report within the usual six month period (see below), the final report will be required within four months of project completion.

The deadline for submitting final reports is six months after the end of the project. It is the task of the co-ordinators to determine a formal end date for project completion. This is required, as partners may be granted extensions of differing duration. Co-ordinators will be informed about this procedure by the Joint Call Secretariat and will receive the report template in due course.

The co-ordinator will be asked to present two progress reports during the intermediate and the final status symposium respectively. Group leaders will be asked to participate in the final status symposium. Travel budgets should be planned and managed accordingly.

Funding recipients must ensure that all outcomes (publications, etc.) of transnational NEURON projects include a proper acknowledgement of ERA-NET NEURON and the respective funding partner organizations, and are in line with the relevant publication requirements.

Annex II Questionnaire / Impact of the Project

IV. Questionnaire / Impact of the Project

This section will be used by ERA-NET NEURON partner organisations to analyse the joint call results. Information resulting from this questionnaire **may be published** in an anonymised manner for **dissemination of the call output**.

Q.1 Publications and communications

Please indicate the number of the publications and communications in which **NEURON support was acknowledged**.

Do not include

- **publications previous to the start date of the project.**
- **publications without acknowledgement of NEURON funding**

Q.1.1 Publications and communications

Type of publication	Total N°
Peer Reviewed Articles	
Books or Book Chapters	
Reviews	
Dissemination Articles	
Communications in Scientific Meetings	
Dissertations	
Others	

Add lines as appropriate

Q.1.2 List of publications and communications

Please list the publications resulting from the funded project.

Please for each publication **highlight the name of the NEURON partners** and indicate the partner number according to the numbering designation in section I (e.g. partner 1 or P1). Please only add publications in which NEURON was acknowledged and **provide a snapshot of the relevant acknowledgment section** for each of the listed publications.

We have uses SCI impact factors and citation counts. For comparison with Google Scholar indexes of these recent works, as a rule of thumb you can double the SCI citation counts.

Publication nu	Type of Publication (Article, Book,	**Publication** (authors, title, journal, year, issue, pp.)	Partner number	Impact factor	Citation Ind	Open access Y/N

Q.1.3 Have the consortium communicated "negative results" as an outcome of the project?

YES NO ☐

►**If YES**, please **(i) indicate** the publication numbers concerned (table above) **(ii) specify** the nature of those negative results (e.g. a murine trangenic model without phenotype):

Q.2 Patents and other outputs with impact to health

Q.2.1 Number of patents, licences and other outputs

Type of patent or licence	Submitted	Obtained
International patents		
EU patents		
National patents		
Licences (exploitation/cession)		
Databases		
Startup/creation of an enterprise		
Other (specify)		

Add lines as appropriate

Q.2.2 List of patents/licences

Please **indicate** if details regarding the listed **patents need to be treated confidentially**

Please indicate the project partners involved using the numbering designation in section I (e.g. partner 1 or P1)

Patent/licence description (patent no./name/description)	**Partner(s) involved**	**Main partner**

Add lines as appropriate

Q.2.3 List of other outputs with impact to health (Database, Startups, other)

Please list below:

Category	Description	Partner(s) involved
software and other prototypes		
launching of a product or service		
new project or contract		
creation of a platform available to a community		
creation of a firm		
fundraising		
others (please specify):		

Q.2.4 Data management

If applicable, please **list** below how the consortium treated and gave access to the data generated

Category	Description	Partner(s) involved
Open data		
Data Repository or data storage		

Data harmonization or data simplification for international standards		
Others (please specify):		

Q.3 Consortium – collaboration and sustainability

Please tick when applicable

Q.3.1 Have the partners participating in the NEURON project collaborated before applying to this NEURON call? YES ☐ NO ☐

►**If YES**, please indicate which partners collaborated (e.g. partner 1 with partner 2, partner 3 with partner 5):

……

Q.3.2 Has the development of the project funded by NEURON motivated the establishment of new collaboration(s) with other team(s)? YES ☐ NO ☐

►**If YES**, please name the institutions and countries and specify the collaboration:

Q.3.3 Have the consortium colaboration led to new applications/grants in other funding programmes? YES ☐ NO ☐

►**If YES,** please specify the partners involved and the corresponding programme (e.g. partners 1 , 3, and 4: FP7 call xy) :

Q.3.4 Intensity of collaboration: Meetings, human mobility and training within the consortium

A. Collaboration meetings (Involving at least two partners of the consortium)

Description Type of meeting (consortium meetings, WP meetings, workshops), location, dates	**Partners involved**

Add lines as appropriate

B. Young scientists' involvement in the project
Please list all the non-permanent personnel involved in the project.

Partner # group	Career stage (Phd, Posdoc, PI…)	Name	Gender	Year of birth	Academic dissertation (year, degree)	Participation on the project (in months)

C. Training and mobility between partners

Please indicate the nature and duration of personal exchanges between consortium partners, based on NEURON funding.

Partner groups (from partner X to partner Y)	Career stage (Phd, Posdoc, PI…)	Name	Purpose of the exchange	Duration of Exchange weeks / months

Q.4 Development of innovative or shared resources and technologies

Q.4.1 Has the consortium created a new or further developed an existing transnational…

Patient registry ☐ Patient database ☐ Biobank ☐ N/A ☐ ?

►**If YES, please complete** (repeat this section as many times as necessary):

- Name of the registry/database/biobank: ……
- How was the registry/database/biobank created?

  Totally new set-up ☐ By compiling national sources that existed already ☐

- How were new patients recruited?
  - Via already existing network of clinicians ☐
  - By the establishment of contact with NEW networks of clinicians ☐
- Please specify how the registry/database/biobank will be maintained/financed after the end of this project ……..

- Is the the registry/database/biobank in open acces

Q.4.2 Have the consortium partners exchanged bioresources (DNA, tissue, cells, animals)?

DNA ☐ tissue ☐ cells ☐ animals ☐ clinical data ☐ N/A ☐

►If YES, please specify:

- Have the shared samples allowed common studies? YES ☐ NO ☐
- Did the number of samples suffice to reach the goal? YES ☐ NO ☐
- Are data / materials made openly accessible (beyond the consorium) YES ☐ NO ☐
  If yes, please specify: …We have plans in sharing these resources after we have througoughly investigated these precious specimens.

Q.5 Potential health impact / achievements

Q.5.1 Have the results of the NEURON research projects allowed the development of new strategies for:

- Diagnosis ☐
- Therapy (Preparation of clinical trials) ☐
- Rehabilitation procedures ☐
- Prevention ☐
- Other (please specify) ……. ☐

►If YES, please briefly describe the strategy/strategies. Also indicate the expected impact and timeframe of translation into clinical application, if possible:

….

Q.5.2 Please list the major achievements of the consortium

Achievements		Please specify
Identification of new genes	☐	
Development of innovative screening systems	☐	

Identification and characterisation of biomarkers	☐	
Validation of biomarkers	☐	
Generation of novel model systems (animal models, cellular models)	☐	
Development of innovative therapies	☐	
New medical treatments	☐	
New medical devices	☐	
Neurosurgical innovation	☐	
Others	☐	

Add lines as appropriate

Q. 6 Patient involvement

Were patients/patient representatives involved in planning and/or conducting the research project?

YES ☐ NO ☐

►If YES, please specify:

- designing the research project ☐
- conducting / coordinating the research project (e.g. patient committee / advisory board) ☐
- analysing / interpreting research data ☐
- dissemination of results ☐

►Please briefly describe the patient involbement:

►If NO, please explain why patients were not involved:

…

Indicator/Measure	AUTISYN	ChromISyn	DeCipher	ImprVision	MicroKin	Neuro-DREAM	RESPOND	SMART	STEM-MCD	SynPathy	TOTAL
New consortium	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	10
Addition of research group	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9
Subsequent applications	YES	YES	YES	NO	NO	YES	YES	NO	YES	NO	6
Intensity of Collaboration											
- number of meetings	7	8	3	6	4	7	5	8	8	5	61
- meetings with all partners	4	4	3	6	2	6	4	8	6	2	45
Excellence											0
- total number of peer reveiwed publications	13	26	9	25	12	38	23	3	34	22	205
- number of joint publications	3	1	4	3	1	3	3	0	6	3	27
- numbr of journals IF > 10	3	2	0	4	5	1	3	0	6	7	31
Composition of consortia											
- coordinator is a medical doctor	NO	NO	YES	NO	YES	NO	NO	YES	NO	NO	3
- number of medical doctors	0	1	2	0	3	1	2	1	1	0	11
- basic research labs involved	4	4	5	5	3	4	5	3	5	5	43
- clinical research labs involved	0	0	0	0	1	0	0	0	0	0	1
- hospitals involved	0	0	0	0	1	0	0	0	0	0	1
Involvement of patients or patient-derived mate	YES	YES	NO	YES	NO	NO	NO	YES	NO	NO	4
Patents (submitted or obtained)	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	2
Databases/registries/biobanks created	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO	3
Exchange of:											
- DNA	YES	YES	NO	YES	NO	NO	YES	NO	YES	YES	6
- tissues	YES	YES	YES	YES	NO	NO	YES	YES	YES	NO	7
- cells	YES	YES	NO	YES	NO	NO	YES	YES	YES	YES	7
- animals	NO	YES	YES	NO	NO	NO	YES	YES	YES	YES	6
- reagents	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	3
- clinical data	YES	NO	NO	NO	NO	NO	NO	NO	YES	YES	3
- experimental data	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- protocols	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	1
Novel strategies for:											
- diagnosis	NO	NO	NO	YES	NO	YES	NO	NO	YES	NO	3
- therapy	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- rehabilitation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- prevention	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- other	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	1
Major achievements:											
- identification of new genes	NO	YES	NO	YES	YES	NO	YES	YES	YES	YES	7
- screening systems	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- identification of biomarkers	YES	YES	YES	NO	NO	NO	NO	YES	YES	NO	5
- validation of biomarkers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- novel model systems	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	10
- innovative therapies	NO	YES	YES	YES	NO	YES	YES	NO	YES	NO	6
- new medical treatments	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- new medical devices	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- neurosurgical innovation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0
- other	NO	NO	YES	NO	NO	NO	NO	NO	NO	YES	2