



# Natural Language Based Decision Support in Neurorehabilitation

ALLADIN is a research project that is funded publicly and jointly funded by its participants and the 6th Framework Programme of the European Commission.

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## List of Partners:

**Arteveldehogeschool** (B)

**Language and Computing NV** (B)

**Budapest University of Technology and Economics** (HU)

**Faculty of Electrical Engineering, University of Ljubljana** (SI)

**Zenon SA, Robotics and Informatics** (EL)

**University of Wales Cardiff** (UK)

**Multitel ASBL** (B)

**Trinity College Dublin** (IRL)

**Országos Orvosi Rehabilitációs Intézet (National Institute for Medical Rehabilitation)** (HU)

**Scuola Superiore Sant'Anna** (I)

# Main Objectives of Alladin Project

The ALLADIN project is a research project that is funded publicly and jointly funded by its participants and the 6th Framework Programme of the European Commission.

It is focused on the development of a user-friendly natural language based decision support software for neuro-rehabilitation, in particular in stroke. ALLADIN, if implemented provides an adequate and fast solution for a client centred practice, for discharge planning and for utilization of rehabilitation resources. This fulfils the social and political expectation of a substantial but honest cost cutting by measuring therapeutic efficiency in terms of mean quality-adjusted duration.

To respond the challenge (

Figure 1) ALLADIN is developing a solution along the following objectives:

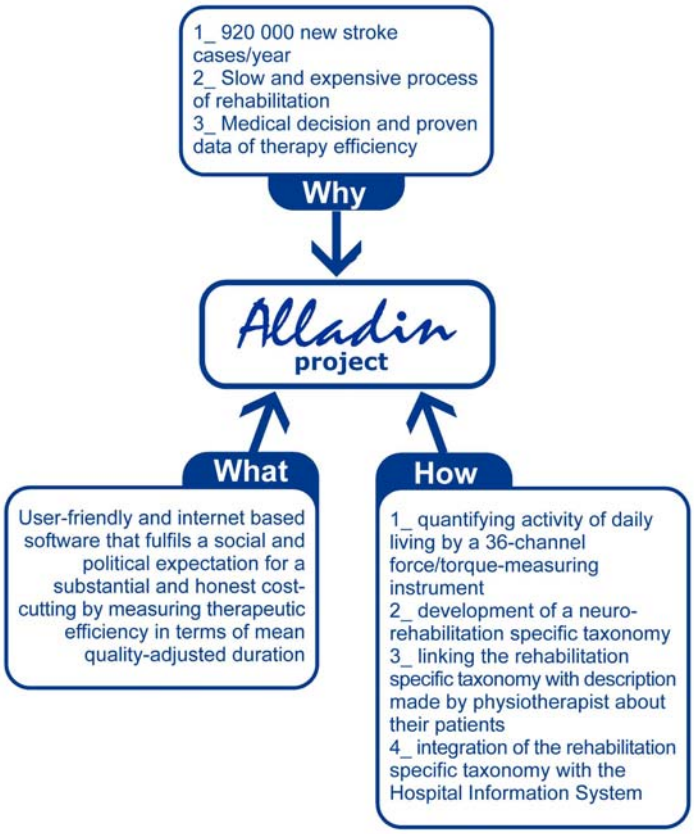


Figure 1 The emergence of ALLADIN

- **To develop a low cost, easy to use, 48-channel force/torque-measuring instrument that samples data about the performance of activity of daily living in stroke patients.**

Leading to:

_ A quantitative database based on the functional performance of 300 stroke patients measured at least 30 times during a period of 6 months.

- **To find evidence-based and noteworthy indicators during stroke recovery by using statistical methods and data mining techniques on the sampled data.**

Leading to:

_ The discovery of at least 10 milestones in recovery and at least 30 predictive markers for functional improvement in stroke. This will be the base for the construction of a rehabilitation specific taxonomy or classification system.

- **To link the rehabilitation specific taxonomy with natural language descriptions. This means the development of an ontology-based classification/coding system for the context of stroke rehabilitation**

Leading to:

_ An ontology for stroke rehabilitation including at least 250 concepts and 2500 terms.

_ An easy to use nomenclature for the rehabilitation professionals. The therapist will be able to use his or her own terminology and the input can be limited to a very accurate description of the patients' actual status.

- **To integrate the Natural Language Understanding middleware with a Hospital Information System.**

Leading to:

_ In the final stage of the project the only thing the clinician remains to do is using a speech interface, telling the computer in a descriptive way about the status of the patient. ALLADIN will inform the clinician immediately on the stage of recovery and will support him for further decisions at the rehabilitation level.

- **To validate the software for health care management in neuro-rehabilitation.**

Leading to:

_ A measurement of therapeutic efficiency in terms of 'mean quality-adjusted duration'. With other words the code that was generated from the description done by a physiotherapist and which is linked to a marker of recovery, will inform the medical advisor or the head of a department in an unambiguous way about the patients' condition. This has very practical implications at the level of input of resources.

_ A standard for European health care policy makers.

_ An economical assessment of the use of ALLADIN.

_ An expansion of the natural languages to be used in ALLADIN.

## Key Milestones

The project milestones of ALLADIN are associated with the three phases of the project workplan (Figure 2).

**Kick-off milestone:**

Three Diagnostic Systems for Force-Torque Measurement Based Therapy Assessment

**Midterm milestone:**

Milestones (at least 10) and predictive markers (at least 30) for functional outcome in stroke recovery derived from a quantitative (biomedical measurements and clinical scales) and qualitative (natural language clinical descriptions) database of 300 European stroke patients

**Final milestone:**

Simple to use, bed side available, speech interface equipped, natural language based stroke patient assessment software tested and assessed in real life situation

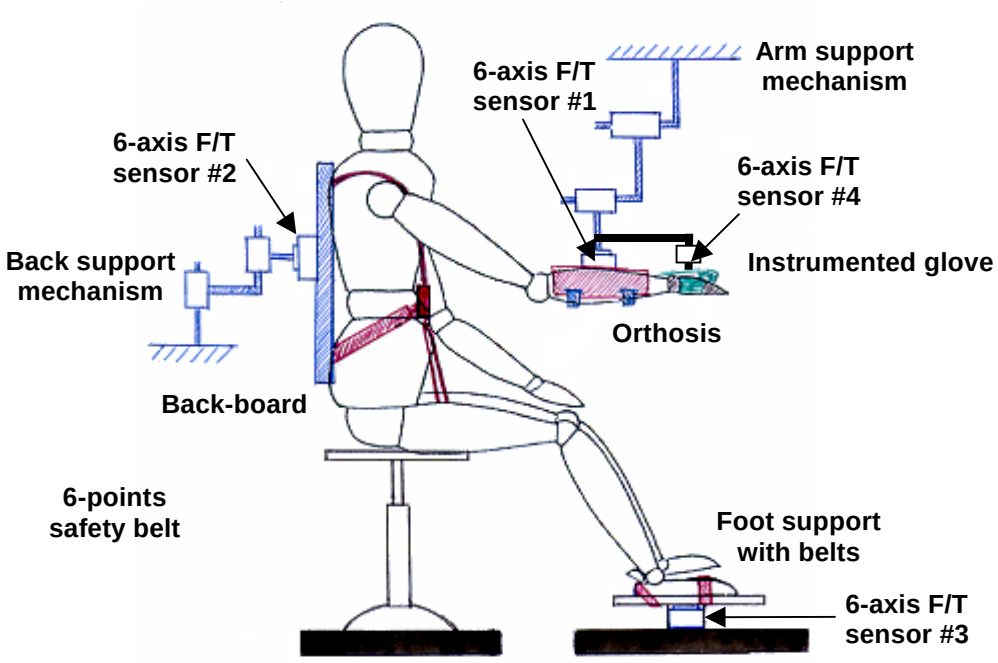


Figure 2 An innovative platform for whole-body isometric force measurement

## Major Innovations

Current clinical techniques for patient assessment routinely rely on subjective and labour intensive techniques involving gross rating scales or the application of motor behavioural tasks using motor proficiency test batteries. Applying current assessment techniques to complex problems encountered during neuro-rehabilitation is impossible. Review of randomised trials shows once more the urgent need to structuring rehabilitation care for stroke patients.

The only key to structured rehabilitation care is a reliable prediction system that can rapidly discover markers for recovery to assist in the difficult decision to choose between continuing therapy, changing or stopping it. The development of ALLADIN is the integrated solution of a combined European effort governing areas of clinical neurology, restorative neurology, neuro-computing, sensor technology, language, speech and communication technology, Artificial Intelligence technology, software development and deployment, telecommunication and health economy. The key standalone technologies are the followings:

- Multiple-channel isometric force/torque-measurements of stroke patients
- Data mining techniques to detect excellent rehabilitation markers
- Speech technology and natural language understanding to serve automated conversion between normalized quantitative measurements, and descriptions made by therapists

ALLADIN will bring revolution in steering neuro-rehabilitation when it will be integrated with the Hospital Information System. From that moment on the therapist can freely describe to a computer the status of the patient at bedside, knowing that this will automatically generate the ALLADIN code linked to the marker for recovery. This will reassure the clinician that a colleague or a health care provider will correctly understand the message and that the patient will receive the right medical approach.

Expected innovations from the ALLADIN project go beyond the current state-of-the-art in the assessment of impairments and disabilities in terms of:

- ALLADIN offers a new and first **reliable standard** for calculating and predicting the functional recovery of stroke patients, which is a crucial factor in client centred evidence-based practice, discharge planning and utilization of rehabilitation resources.
- ALLADIN creates **conformity** in the communication and understanding of neuro-rehabilitation data. This is a prerequisite for taking prompt and right decisions in stroke rehabilitation.
- ALLADIN makes clinical assessments and quantitative measurements **exchangeable** and fulfils in this way the wishes of therapists for user-friendly, fast and reliable evaluation methods.
- ALLADIN outputs a **code** attached to an operational definition of a milestone or marker in functional recovery comparable with the International Classifications of Diseases (ICD) and has at the same time a trend-setting function for the further elaboration of the International Classification of Functioning and Disabilities (ICF) with the objective to improve further multidisciplinary responsibility and coordination of interventions.

# Expected Benefits

Prevention and treatment of stroke have become recognized health priorities in most European countries. Epidemiological studies have shown that incidence, prevalence and mortality **differ widely through Europe** (Figure 3), and that the increasing socio-economical burden resulting from stroke disability also shows marked differences between eastern and western European countries.

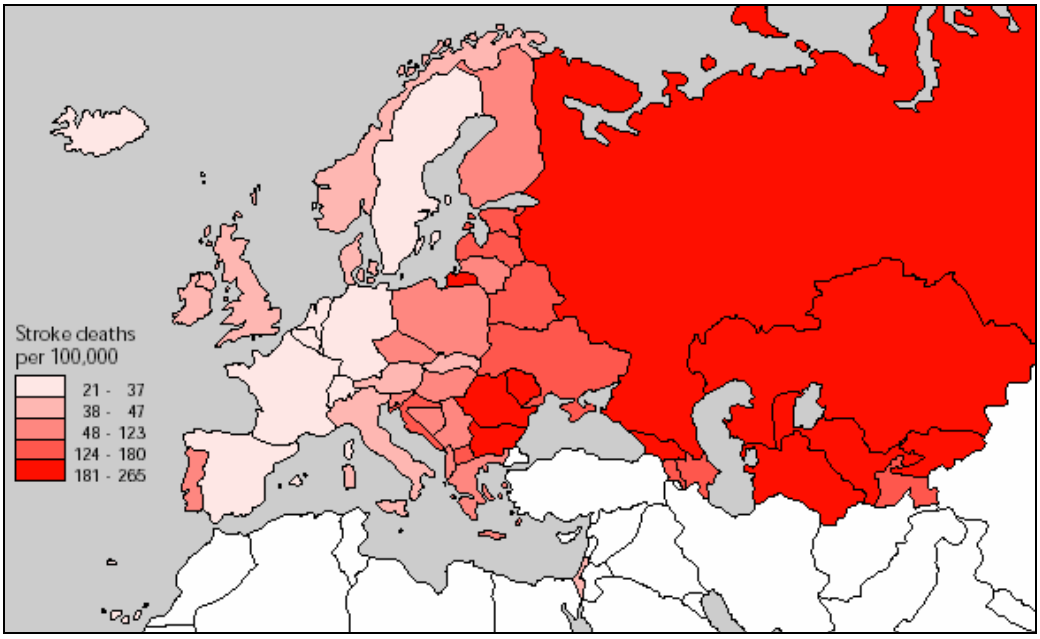


Figure 3 Stroke death rates in Europe and in Middle Asia

Stroke patients, healthcare professionals, and healthcare providers are the key players who would benefit from the project developments.

**Stroke patient:**

The rehabilitation professional examines the patient and tells his/her findings to the computer in a descriptive way. The computer replies automatically with a message, which is a marker or milestone for recovery for that particular patient and this message helps to decide what to do next.

**Healthcare professional:**

Because neuro-rehabilitation is strongly branched in different therapeutic approaches it makes evidence based practice very difficult. Two solutions can be offered for this problem:

_1. Impose strict guidelines of evidence-based therapy or

_2. Accepting freedom of therapy choice controlled by the new easy to use ALLADIN evaluation instrument.

**Healthcare provider:**

Cost cuts arisen from using ALLADIN can be grouped as follows:

- Radically reduced time and human/equipment resources for patient assessment.
- 20% reduction in the relative rehabilitation cost per patient is foreseen. Increase of the patient turnover.

The ALLADIN approach withstands the imminent tendency of pruning expenses for rehabilitation using only 'time spent in therapy' as a decision-making criterion.

**Healthcare policy maker:**

To strengthen the evidence base for a health strategy such as neuro-rehabilitation, is important because National health services all over Europe have been underlining very strongly the importance of improving effectiveness in healthcare by decision making that affect the care of patients are taken with due weight according to all valid, relevant knowledge. ALLADIN outputs a code attached to an operational definition of a milestone or marker in functional recovery comparable with the International Classifications of Diseases (ICD) and has at the same time a trend-setting function for the further elaboration of the International Classification of Functioning and Disabilities (ICF) with the objective to improve further multidisciplinary responsibility and coordination of interventions.

An important ethical issue in Europe is the wide variation in practice across countries. To estimate future European trends in neuro-rehabilitation and to compare their quality, a unified system for patient assessment and decision support in stroke must be developed. This system can only be created when several countries, with different health policies are involved in the development of the new instrument.

For that reason 3 hospitals from different European Member states are included in clinical data collection. These hospitals are the St. James Hospital in Dublin, Ireland, the Maria Middelares Hospital in Gent, Belgium, and the Szent János Hospital in Budapest, Hungary.

# Why should I contact the ALLADIN Project team?

1. To know more about the ongoing project achievements
2. To be involved in the clinical and industrial exploitation of results
3. To know the results of the clinical trials scheduled in 2005/2006 and beyond

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