Laboratory of Research of Neuromotor Rehabilitation

via Mercalli 32-20122 Milano, Italy
ph +39 0258218150
fax +39 0258218155
MISSION

The mission of the Lab is to support clinical-empirical research on exercise methods with both pathophysiological cues and scientific validation, according to a circular bedside-bench-bedside translational approach. This implies:

a) close collaboration between the clinical and the research teams within a Clinical Rehabilitation unit, both in generating hypotheses and running the experimental trials;

b) an effective network of collaboration either across the Lab units, or with external research teams. Foreign collaboration is in progress with Belgium, Israel, UK, and the USA.
**WHAT**

The Laboratory carries out research in the area of human movement control with a special emphasis on the mechanisms underlying nervous impairments and repair, as well as functional recovery, either spontaneous or prompted by rehabilitation. The Lab is articulated into three complementary units: a clinical neurophysiology lab (NeuroLab), a gait analysis lab (GaitLab), and a psychometric lab (PsyMLab).

**WHEN**

The Lab was established shortly after the Clinical Unit of Neuromotor Rehabilitation, in September 2004.

**WHERE**

The Lab is nested within 40-bed free-standing rehabilitation unit, belonging to a teaching hospital located in central Milan. The clinical unit has about 60 members of staff and admits about 500 sub-acute inpatients and 150 outpatients/year. Eighty percent of the patients present with sensory-motor impairments caused by neurological diseases (stroke, multiple sclerosis, myelitis etc.) or from the after -effects of neurosurgical operations (on brain tumors, vascular malformations etc.). About 20% of the patients suffer from orthopedic impairments (mostly hip or knee joint replacement).

**WHO**

The Director is prof. Luigi Tesio who is personally engaged in research programs run by each of the sub-units. Given his dual role and affiliation (as Professor and Chief of the Clinical Unit) the Lab research is conducted jointly by the Istituto Auxologico Italiano (one of 40 nationally acknowledged research hospitals, IRCCS) and the Department of Human Physiology of the School of Medicine at the Università degli Studi di Milano. The team includes M.D. specialists in Physical Medicine and Rehabilitation, a Bioengineer, a Statistician, and secretarial staff.

**WHY**

The Lab's location within a clinical unit allows easier access to cases with CNS lesions, during the early or the late stages of recovery following nervous lesions. It also makes it easier to study the results of motor and cognitive exercise treatments. The circulation of ideas among the collaborating biomedical and clinical teams is greatly facilitated. These opportunities have been steered towards: a) elucidating the biological and the behavioral mechanisms of motor impairments, and of either adaptive or intrinsic recovery and b) supporting the development and the validation of innovative exercise approaches and of outcome measures.
A CLOSER LOOK

Each of the Lab’s three units is dedicated to specific areas of research.

1. **NeuroLab**

Here research is focused on the neurophysiology of recovery of voluntary movement after nervous lesions, with a special emphasis on the correlates of rehabilitation.

The NeuroLab is equipped with advanced technologies for neuromotor testing:

- Electromyography (neurography and needle examination)
- Transcranial magnetic (TMS) and direct current (tDCS) stimulation
- Neuronavigation and brain imaging reconstruction, for TMS brain mapping
- High-current muscle stimulators
- Visuo-vestibular diagnostics (VOR testing, eye-tracking, computerized campimetry, “subjective vertical” testing)
- Balance testing (static and dynamic-EquiTest/EMG posturography).

**Cutting edge/hot topic:**

effort/force relationship after stroke (capacity for maximal voluntary recruitment), before and after therapeutic exercise.
This Lab focuses on the pathophysiology of gait and posture. Kinematic, dynamic and muscle recruitment of walking are investigated through the classic instrumental triad: optoelectronic recording of skin reflective markers, ground force transducers, surface EMG from key muscles, respectively. At variance with the conventional setting, gait is recorded on a pair of treadmills (one for each lower limb) mounted on 3-D force transducers (so-called instrumented, split-belt treadmill). The imposed walking speed is known and constant. Several reproducible strides can be recorded in a few seconds. This allows very brief sessions, tolerated by most patients. Also, since the whole body system always rests on force sensors during walking, the motion of the body center of mass (COM) can be directly assessed from ground reactions (so-called “Newtonian” method).

**Cutting edge/hot topic:**

description and parameterization of the COM trajectory during gait. Development of clinical indexes of “balance during gait” in ataxic patients, before and after therapeutic exercise.
3. **PsyMLab**

The psychometric lab works on statistics, epidemiology and research epistemology. Its focus is on the assessment of human behaviors and perceptions with extensive application of Rasch statistical modeling, and it is at the forefront of research on the “outcome” of rehabilitation at the person-environment interface. The Lab is mostly engaged in the development of new quantitative questionnaires and runs data analysis within psychometric, epidemiological and cost-effectiveness studies related to disability and rehabilitation. It also works on methodological (e.g., variable construction, trial design) and ethical issues (e.g. evaluating Quality of Life) involving Rehabilitation Medicine.

**Cutting edge/hot topic:**

web implementation of the FIMTM-Functional Independence Measure data-set, for either managerial policies or multicentre epidemiological studies. Web-based linearization and quality check of raw questionnaire scores, though server-based, “back-stage” Rasch analysis.


Tesio L. From codes to language: is the ICF a classification system or a dictionary? BMC Public Health. 2011;11 Suppl 4:S2


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