

# Economic and organizational advantages of MRgFUS for the treatment of essential tremor in Italy

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## Rationale of the study

- **Essential tremor (ET)** represents the most common movement and neurological disorder (Louis & Faust, 2020)
- **Pharmacologic treatments** are recommended by medical societies as **first-line treatment for ET symptoms** (Zesiewicz *et al.*, 2011). However, it is estimated that ~50% of ET patients will not experience any therapeutic effect (Zesiewicz *et al.*, 2011; Koller *et al.*, 2011) or will suffer from side effects (Louis, 2012)
- While there have been little progresses in the ET medical treatment, over the past decades, **several remarkable achievements have occurred in the surgical field, such as thalamic deep brain stimulation (DBS)** for patients with medication-resistant tremor (Benabid *et al.*, 1991; Blomstedt *et al.*, 2007; Koller *et al.*, 2000; Mohadjer *et al.*, 1990; Hariz *et al.*, 2008)
- However, **the most recent advance in this area is the magnetic resonance-guided focused ultrasound (MRgFUS)**, that has emerged as an incisionless medical procedure that applies high-intensity focused ultrasound energy to ablate tissues through thermal coagulation. **This technique is CE-approved for the unilateral and staged bilateral treatment of patients suffering from medical refractory essential tremor (mr-ET)**
- Despite the level of clinical evidence reporting significant improvements in tremor, disability, and quality of life as well as the existing guidelines by medical societies worldwide, **the treatment is still not commonly performed in Italy**

## Primary objective of the study



To define the economic and organizational hospital advantages of MRgFUS implementation in Italy, for the unilateral treatment of essential tremor (mr-ET), compared to unilateral Deep Brain Stimulation (DBS)

## Methods

- A process mapping technique, grounding on a **time-driven activity-based costing approach – TDABC** – was implemented to define MRgFUS inpatient procedure and DBS economic resources absorption (Kaplan & Anderson, 2007; Keel *et al.*, 2017), assuming the hospital perspective
- DBS and MRgFUS procedures were divided into four phases: 1) Pre-Surgery activities; 2) Patients’ admission; 3) Surgery; 4) Hospitalization. Each phase was determined, measuring the costs arising from the resources’ consumption in the hospital, in terms of direct costs related to the provision of care, such as physician and nursing staff salaries, and expenditures on medications or other medical supplies
- In addition, a **Budget Impact Analysis** was conducted to verify MRgFUS’s economic sustainability based on the Italian population with mr-ET: The “baseline scenario” in which all the Italian patients were treated with the surgical approach (DBS) was compared with two innovative scenarios, in which the innovative MRgFUS is used: the innovative Scenario 1 hypothesized that the eligible population may be equally distributed between technologies, whereas Innovative Scenario 2, representing the “best-case scenario” (in terms of potential MRgFUS use) hypothesized that all mr-ET patients could be treated with MRgFUS, except for 1.94% that represented patients with claustrophobia who could not undergo MRI (Calabrese *et al.*, 2009; Eshed *et al.*, 2007)
- The **organizational analysis** includes the definition of a release in hospitalization days, in terms of increased beds’ availability due to shorter length of stay (LOS) equal to 3 and 7.70 for MRgFUS and DBS respectively (MRgFUS: 2 nights; DBS: 6.7 nights)

## Results from the study

MRgFUS represents the less expensive treatment option, generating a **direct economic saving per patient of 30%** with respect to DBS (19,962€ vs 28,337€)

	MRgFUS	DBS
Pre-Surgery Activities	646 €	646 €
Patients’ admission	12 €	12 €
Surgery	15,087 €	21,570 €
Hospitalization	891 €	1,386 €
General costs	3,327 €	4,723 €
<b>Total cost</b>	<b>19,962 €</b>	<b>28,337 €</b>

Based on the target population and on the different market shares used in the BIA, a **standardized use of MRgFUS would lead to a decrease in the length of stay (LOS), ranging from a minimum of 35% to a maximum of 69%, with a consequent positive impact on an increase in the accessibility to care**



When considering the overall Italian adult population with mr-ET that seek treatment (20.3% - Romero *et al.*,2012), being refractory to medication (50% - Zesiewicz *et al.*,2011) and eligible to surgery (85% - Health Quality Ontario,2018), thus representing 37,679 mr-ET patients, **an overall economic benefit ranging from 15% to 29% emerged**

	Baseline Scenario	Innovative Scenario 1	Innovative Scenario 2
Total costs for mr-ET patients treated with DBS	1,067,703,462 €	533,851,731 €	20,713,447 €
Total costs for mr-ET patients treated with MRgFUS	0 €	376,076,269 €	737,560,779 €
<b><i>Total costs</i></b>	<b><i>1,067,703,462 €</i></b>	<b><i>909,928,000 €</i></b>	<b><i>758,274,226 €</i></b>
<b>Difference between Baseline Scenario and Innovative Scenario 1</b>		<b>-157,775,462 € (-15%)</b>	
<b>Difference between Baseline Scenario and Innovative Scenario 2</b>		<b>-309,429,236 € (-28%)</b>	

	Baseline Scenario	Innovative Scenario 1	Innovative Scenario 2
Total LOS for mr-ET patients treated with DBS	252,451	126,225	4,898
Total LOS for mr-ET patients treated with MRgFUS	0	37,679	73,897
<b><i>Total LOS</i></b>	<b><i>252,451</i></b>	<b><i>163,905</i></b>	<b><i>78,794</i></b>
<b>Difference between Baseline Scenario and Innovative Scenario 1</b>		<b>-88,546 (-35%)</b>	
<b>Difference between Baseline Scenario and Innovative Scenario 2</b>		<b>-173,657 (-69%)</b>	

## Conclusions

- Results revealed **MRgFUS economic and organizational sustainability**, demonstrating that treating all eligible mr-ET patients with DBS is unlikely to be an effective strategy from a resource allocation perspective
- This is even more relevant in view of the early but **promising results of MRgFUS in the treatment of patients with Tremor-Dominant Parkinson’s Disease** (Bond *et al.*,2017), **asymmetric Parkinson’s Disease** (Martinez *et al.*,2020), and **advanced PD patients** (Krishna *et al.*,2023)
- MRgFUS may be considered a valid alternative to DBS, **encouraging regional and national healthcare authorities to ensure therapy adoption**

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