

Linköping University medical dissertations No. 1644

**STUDIES ON SPASTICITY  
FROM AN  
INTERVENTIONAL PERSPECTIVE**

Per Ertzgaard



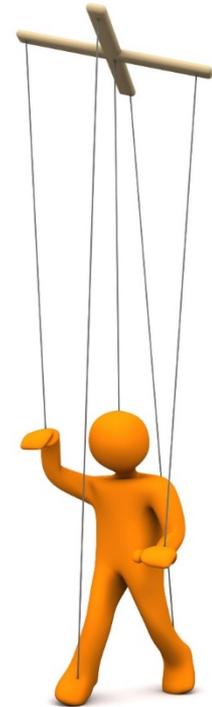
## LIST OF PAPERS

**Paper I:** Ertzgaard, P., Ward, A. B., Wissel, J., & Borg, J. (2011). Practical considerations for goal attainment scaling during rehabilitation following acquired brain injury. *J Rehabil Med*, 43(1), 8-14.

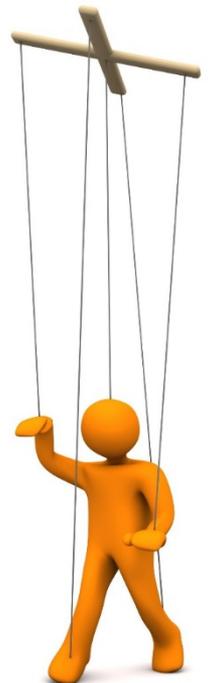
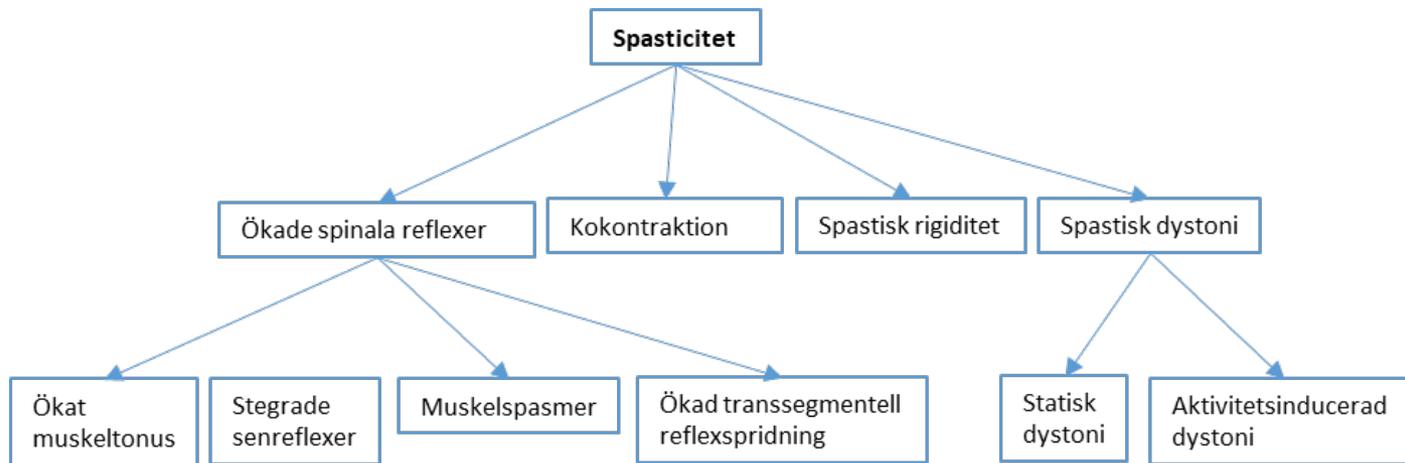
**Paper II:** Ertzgaard, P., Öhberg, F., Gerdle, B., & Grip, H. (2016). A new way of assessing arm function in activity using kinematic Exposure Variation Analysis and portable inertial sensors--A validity study. *Man Ther*, 21, 241-249.

**Paper III:** Ertzgaard, P., Anhammer, M., & Forsmark, A. (2017). Regional disparities in botulinum toxin A (BoNT-A) therapy for spasticity in Sweden: budgetary consequences of closing the estimated treatment gap. *Acta Neurol Scand*, 135(3), 366-372.

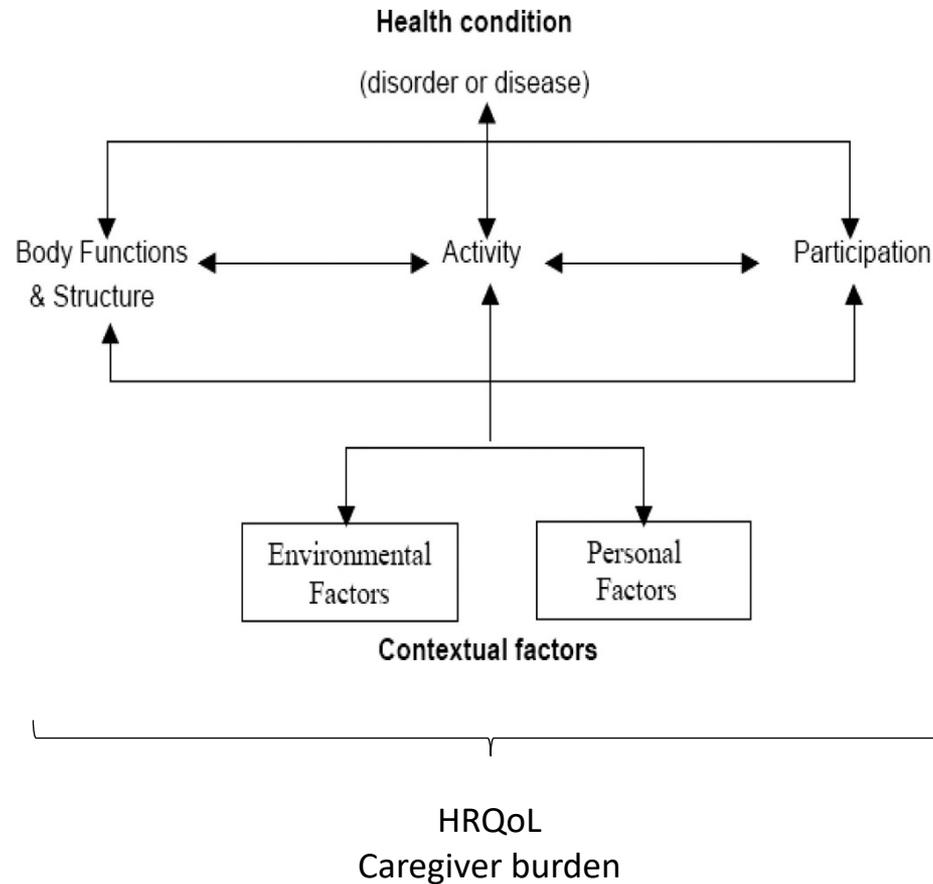
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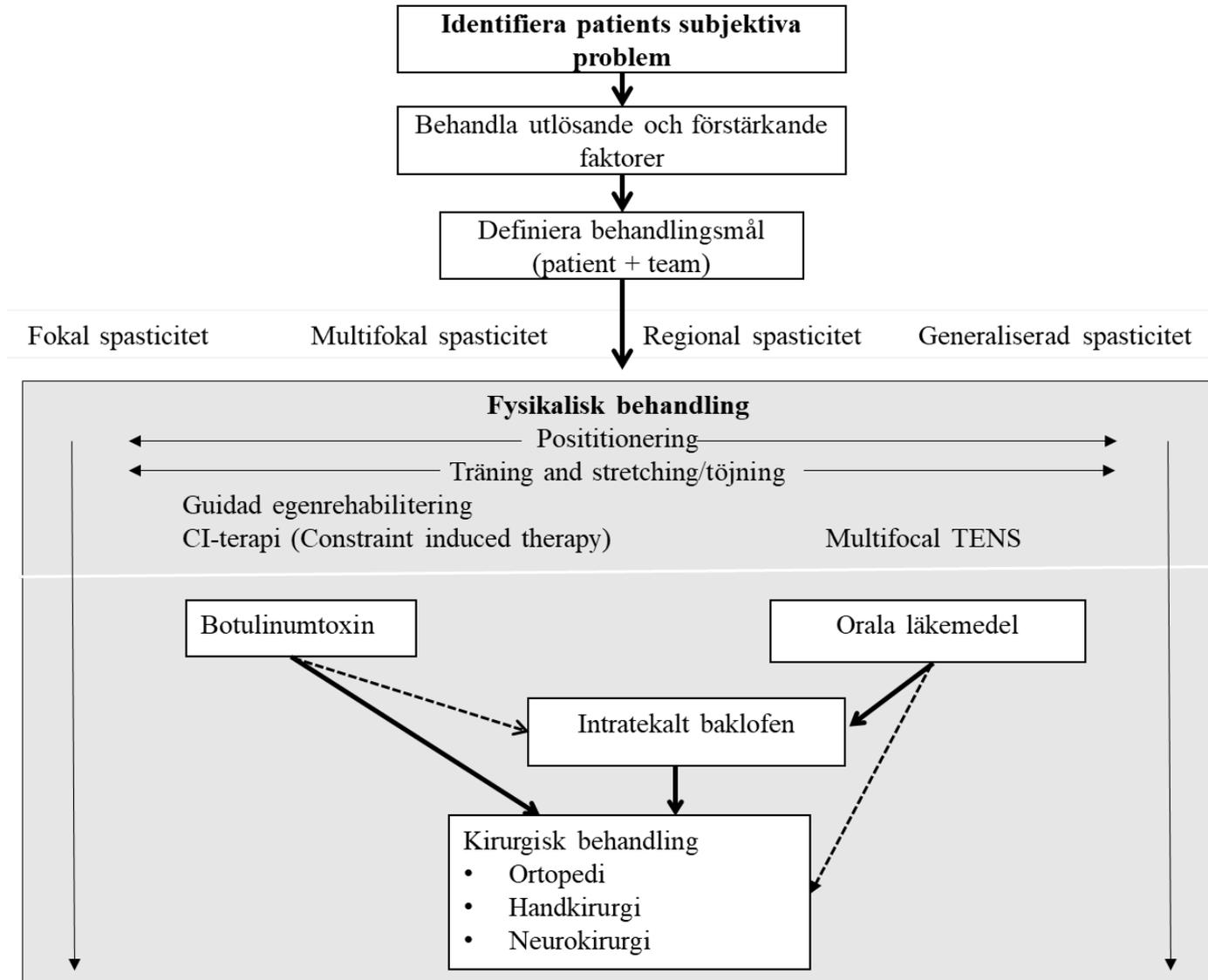
# Components of spasticity



# The International Classification of Functioning, Disability and Health” (ICF)



# Handläggningssalgorithm



**Paper I:** Ertzgaard, P., Ward, A. B., Wissel, J., & Borg, J. (2011). Practical considerations for goal attainment scaling during rehabilitation following acquired brain injury. *J Rehabil Med*, 43(1), 8-14.

- **Method:**

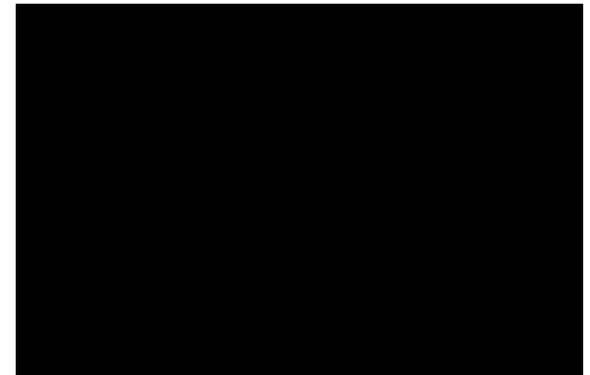
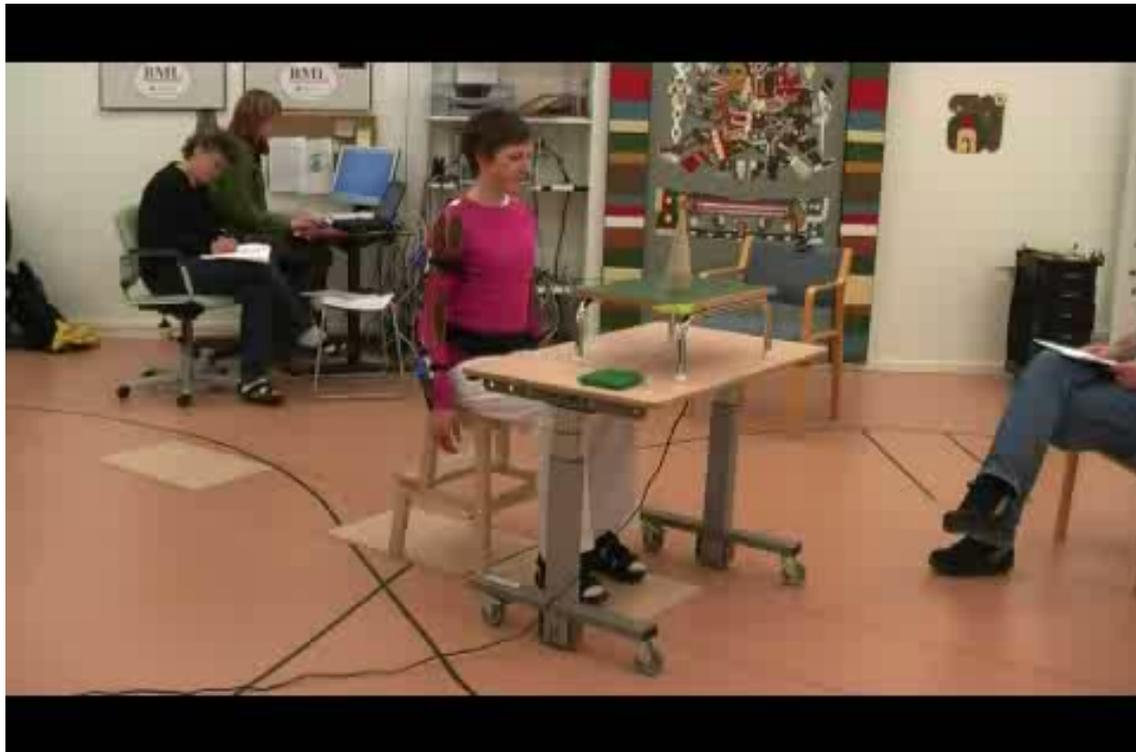
Literature review capturing the most pertinent information on GAS concerning advantages, disadvantages, practical aspects and controversies

- **Conclusion:**

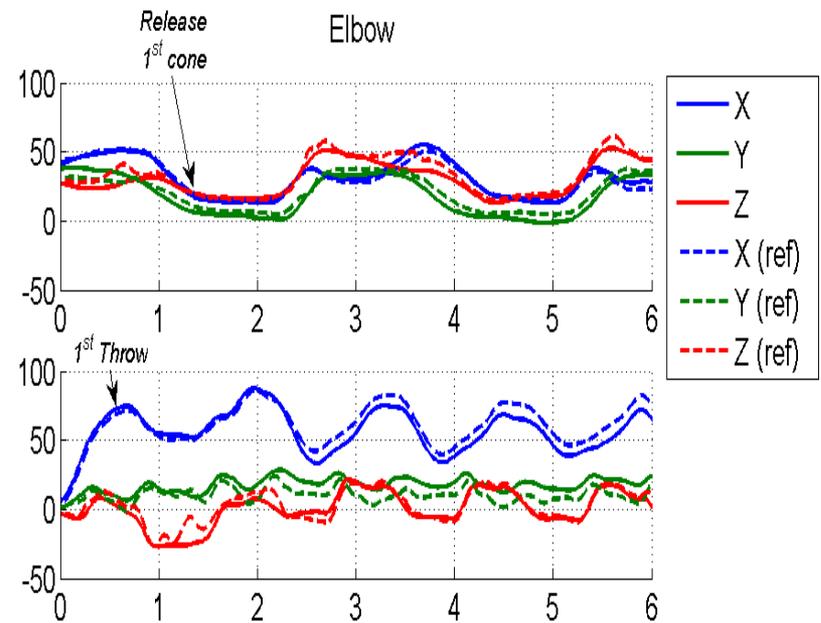
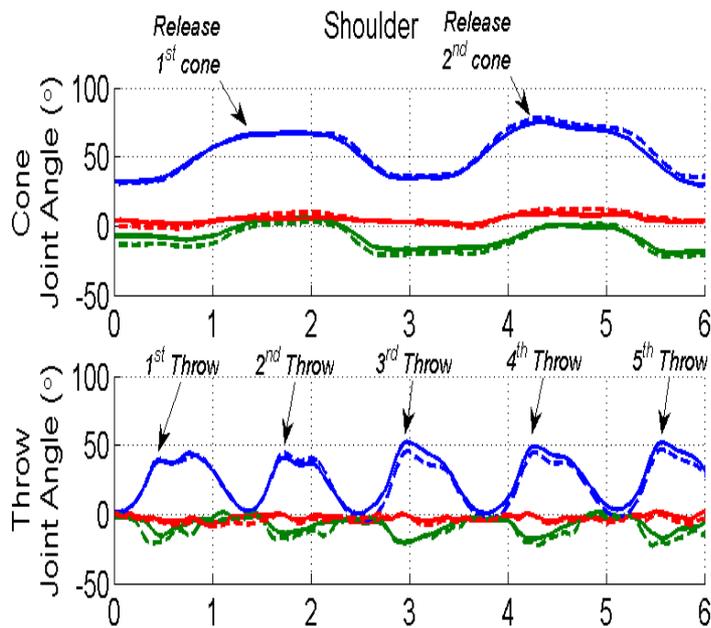
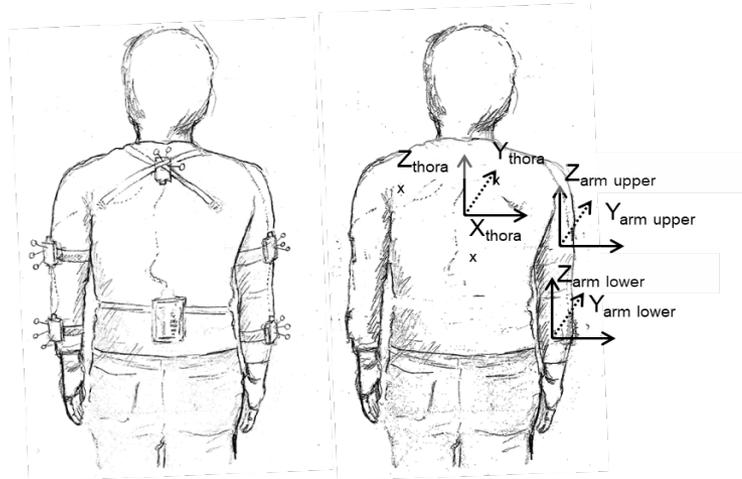
The paper pointed out necessary aspects to consider when using this instrument. This relates, among other things, to the *need of learning* (“the art of”) goal setting and *deciding the purpose* of the measurements. Research and clinical use puts different demands on the instrument, for the latter time-efficiency and simplicity to use being most important. For research, it is important to be able to *register deterioration*, and this can be achieved using the 6-step version.



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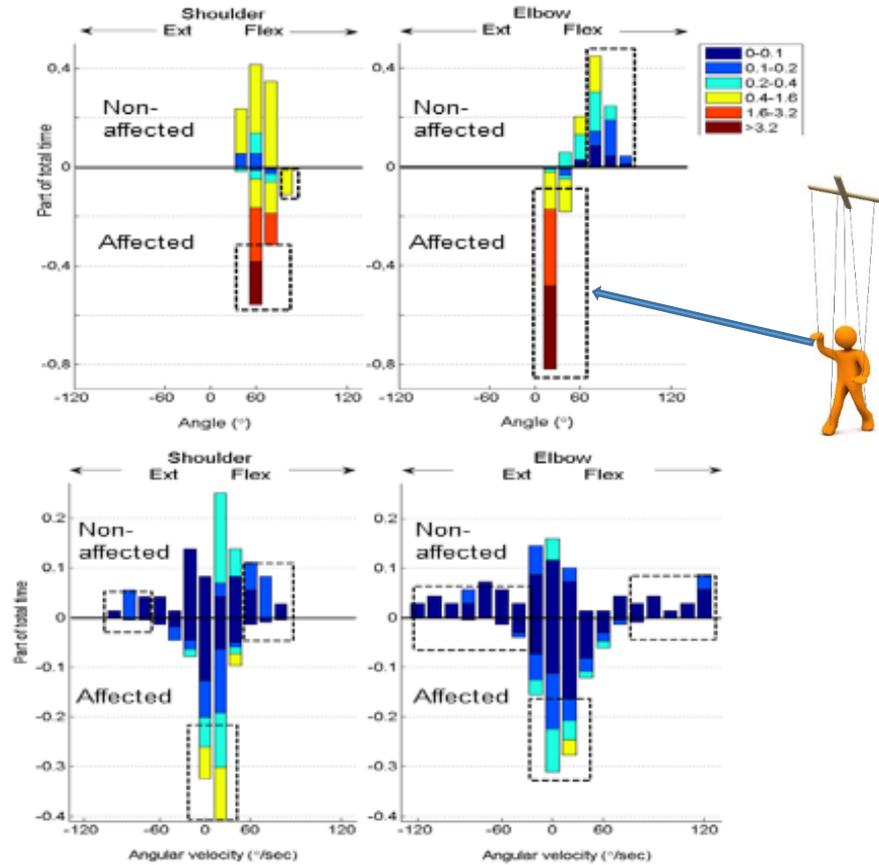


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- **Conclusion:**
- Measurements were valid, with a good to excellent correlation compared to the “gold-standard” system.
- Exposure Variation Analysis is a useful tool for presenting data as it could discriminate between different types of arm activities and between the affected and non-affected arm in the participant with PSS
- There were a drift of the signal, which needs adjustment if used for longer registrations



**Paper III:** Ertzgaard, P., Anhammer, M., & Forsmark, A. (2017). Regional disparities in botulinum toxin A (BoNT-A) therapy for spasticity in Sweden: budgetary consequences of closing the estimated treatment gap. *Acta Neurol Scand*, 135(3), 366-372.

- **Method:**  
Health economic analysis using registries and published data. Assumptions and insecurities in data quality adjusted by a sensitivity analysis.
- **Conclusion:**
  - The study showed that there are large differences in Sweden concerning the use of BoNT-A for spasticity in adults. The county with the highest use used 270 % more than the county with the lowest use.
  - The study found strong support for cost-effectiveness of BoNT-A treatment for spasticity.
  - The cost for reaching equality in access to BoNT-A treatment would be approximately 9.4 million EUR for all of Sweden



# Assumptions

Assumption/uncertainty	Rationale for chosen strategy
Uniform regional prevalence of diseases, spasticity and disabling spasticity	Sweden is relatively homogeneous concerning ethnical and sociodemographic background.
The prevalence of disabling spasticity reflect the proportion of patients eligible for BoNT-A treatment	This is probably an overestimation of the population, as it includes both focal and generalized spasticity, where only the focal type is eligible for BoNT-A treatment.
The hospital part of BoNT- A use was considered to comprise all spasticity treatment	Swedish health-care is publically funded, and private care for spasticity is close to non-existing, except for the Stockholm county. For the latter, a validation was performed, taking in account the private actors.
Conversion ratio between the different BoNT-A brands is lacking	For the calculations we needed the total volume of BoNT-A used for spasticity and the article by Ravenni [155] was chosen as a new, unbiased source for this conversion between brands.
Patients receive three treatment cycles annually	This was based on data from one county. If this varies between the counties, it can affect the calculations. Has to be considered in future studies.
The cost of spasticity (i.e. the savings in cost by reducing spasticity severity)	This is based on two articles, on stroke and MS, respectively. This cost is generalized to all conditions. The most conservative cost estimation was chosen, and a sensitivity analysis was performed reducing the cost reduction of decreasing spasticity down to 25% of the base case.
The county with the highest use of BoNT-A is closest to optimal level of treatment	Since there is a lack of spasticity treating physicians, a lack of guidelines (except in the county with highest use) and a pressure for reducing costs in the health-care system it is reasonable to assume an under-utilization in BoNT-A treatment.

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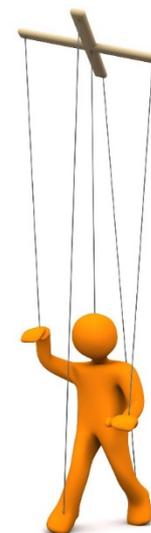
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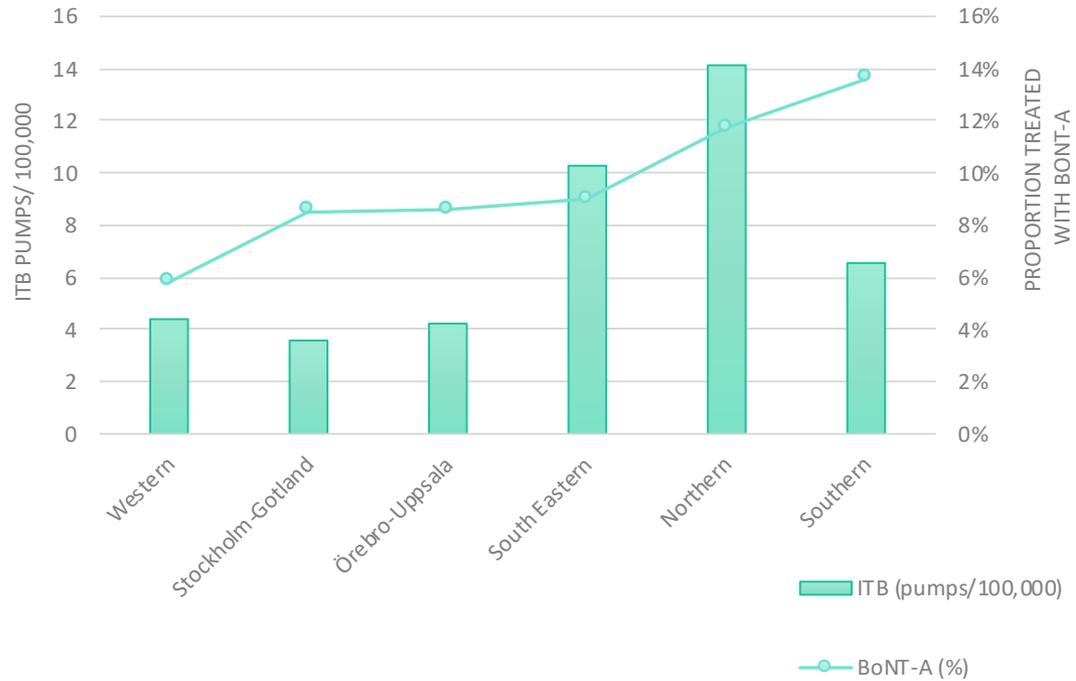
# Sensitivity analysis

Scenario	Total incremental number of equivalent doses	Total incremental number of patients to treat	Total incremental cost, intervention (EUR 2014)	Proportion of incremental treated number required to change severity grade for cost neutrality*
Base case <sup>1)</sup>	5,342	1,781	9,424,755	12%
Adjusted prevalence <sup>2)</sup>	7,272	2,424	12,828,858	12%
Max. treatment gap <sup>3)</sup>	9,869	3,290	17,411,540	12%
Association between spasticity and costs <sup>4)</sup>				
75%	5,342	1,781	9,424,755	16%
50%	5,342	1,781	9,424,755	24%
25%	5,342	1,781	9,424,755	47%

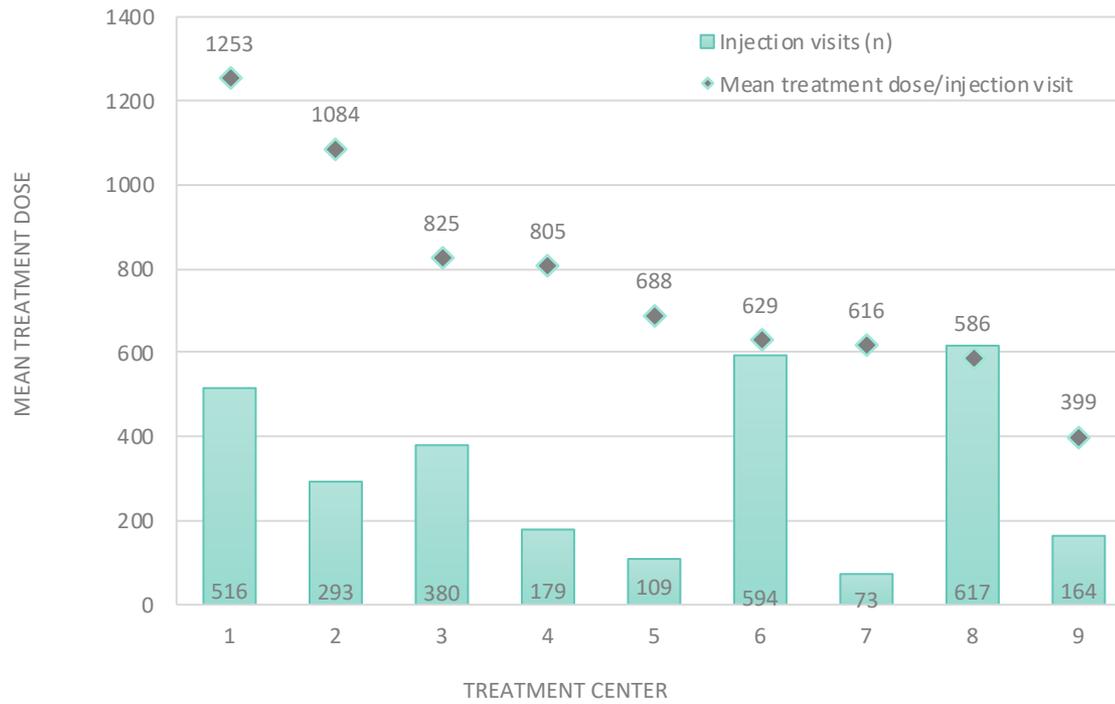
\* Expected number of converting severity grade after BoNT treatment > 50%



# Paper IIIb

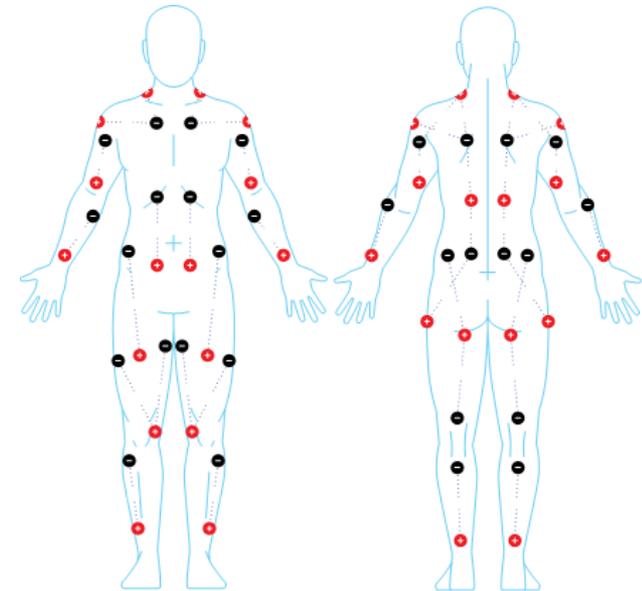


# Paper IIIb

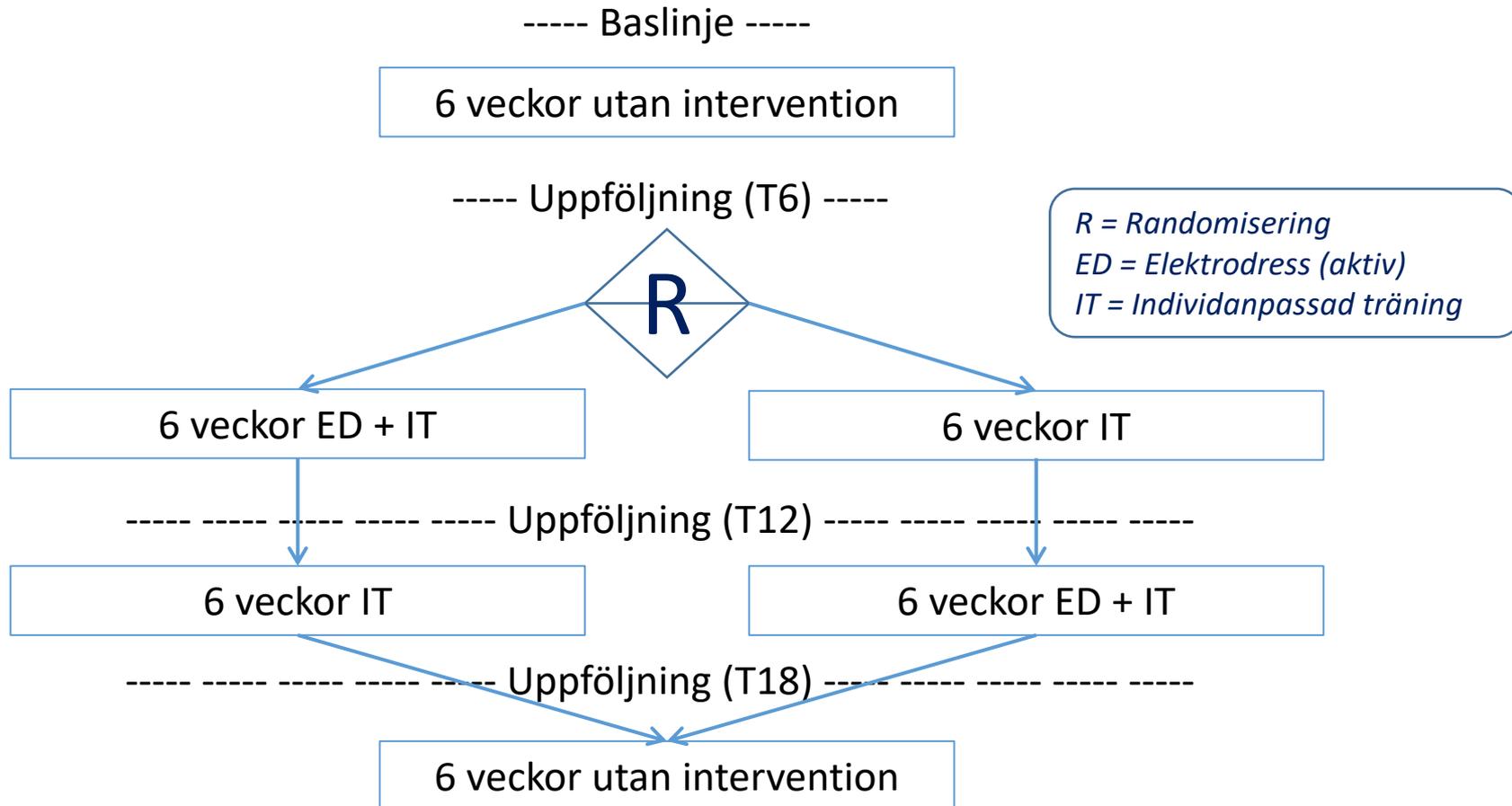


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- Self-treatment therapy
- 58 electrodes in a full-body garment
- Major muscle groups can be individually stimulated
- Programmable control unit using different stimulation amplitudes for each stimulated muscle
- Square pulse at a frequency of 20 Hz
- Recommendation of 60 min of stimulation each second day during training



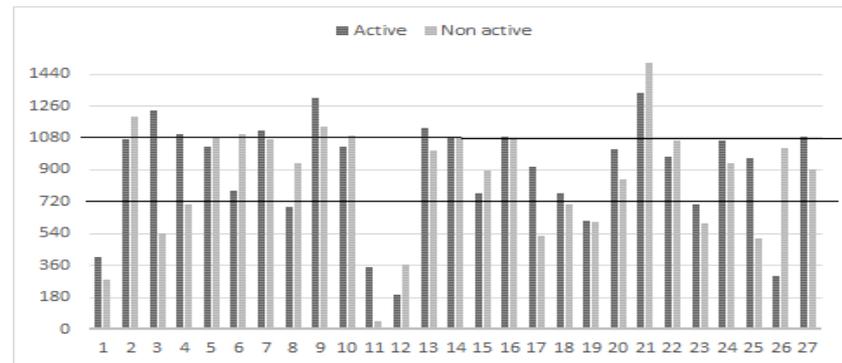
# Studieplan



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## Conclusion

- No difference between active and non-active treatment
- Too many adverse events for study to be conclusive
- Individual reports on treatment effect



Deviations and adverse effects	Number of reported adverse effects and deviations	Number of participants reporting adverse effects and deviations
Pain <sup>1</sup>	8	6
Technical problem – garment <sup>2</sup>	26	16
Technical problem – control unit <sup>3</sup>	23	17
Contact, logistical and/or comfort problems <sup>4</sup>	14	13
Increased need for assistance <sup>5</sup>	2	2

# when, where, what? -doing research in the right order

