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ORIGINAL REPORT

INTERDISCIPLINARY SPASTICITY MANAGEMENT CLINIC OUTCOMES USING THE GOAL ATTAINMENT SCALE: A RETROSPECTIVE CHART REVIEW

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Objective: **To generate practice-based evidence of outcomes in an interdisciplinary spasticity management clinic using practical application of the Goal Attainment Scale (GAS).**

Design: **Retrospective chart review.**

Patients: **A total of 225 adult patients who were referred for spasticity management at a tertiary rehabilitation hospital and returned for follow-up between 2010 and 2013.**

Methods: GAS scores were determined for all patients. GAS T-scores were evaluated based on age; sex; diagnosis; International Classification of Functioning, Disability and Health (ICF) domain; body region affected; and site of botulinum neurotoxin injection.

Results: **The distribution of GAS outcomes did not vary by age, sex or diagnosis. The overall GAS T-score for the clinic was 47.7, which is consistent with appropriate goal setting. GAS T-scores did not vary by diagnosis or ICF domain. Significant intervention effects were identified for botulinum neurotoxin, with improvements in GAS T-scores for treatment targeted to both upper and lower limb muscles, compared with no botulinum neurotoxin, across diagnoses and ICF domains.**

Conclusion: **The GAS is a useful patient-centred outcome measure that can be practically applied in the clinical setting for a heterogeneous population with diverse goals. Botulinum neurotoxin treatment in this setting was associated with improved goal attainment relating to multiple ICF domains.**

Key words: muscle spasticity; botulinum toxin; outcome assessment; patient care team.

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Spasticity is defined as "disordered sensori-motor control, resulting from an upper motor neurone lesion, presenting as intermittent or sustained involuntary activation of muscle" (1). Upper motor neurone lesions occur with conditions such as spinal cord injury (SCI), stroke, acquired brain injury (ABI), multiple sclerosis (MS) and cerebral palsy (CP). Spasticity causes significant disability in these populations.

Guidelines suggest that spasticity is best managed in the setting of an interdisciplinary team (2). The challenge for interdisciplinary spasticity clinics is the heterogeneity amongst patients, both in underlying diagnoses and goals of treatment. For example, 2 patients with flexor posturing of the upper arm due to post-stroke spasticity may have similar examination findings; however, their motivations for treatment may be very different. One patient may want to reduce the difficulty of hand hygiene and the other may want to improve the ease of dressing. Hence, measuring treatment success in such a heterogeneous population can be a challenge. This has probably also affected conclusions of previous studies of botulinum neurotoxin (BoNT) for limb spasticity, as measures that are based solely on body structure and function may not capture important patient-centred outcomes.

The Goal Attainment Scale (GAS) is a patient-centred outcome measure of clinically meaningful change. It is one of the recommended outcome measures for spasticity management and has been validated in the rehabilitation setting (3–5). It is used as a tool in our interdisciplinary spasticity clinic to set goals according to the SMART principle (Specific, Measurable, Attainable, Realistic, Timely), to establish therapeutic alliance, and to measure treatment success.

Practice-based research is defined as, "the use of research-inspired principles, designs and information gathering techniques within existing forms of practice to answer questions that emerge from practice in ways that inform practice" (6). While evidence from controlled trials is considered the gold standard of research, generation of practice-based research is emerging as an important approach that reflects how variability within clinical practice can affect outcomes in a way that is not otherwise captured.

The aim of this study was to generate practice-based evidence of outcomes in an interdisciplinary spasticity management clinic using practical application of the GAS. Secondary objectives were to identify patient factors or goal characteristics that conferred a higher likelihood of successful treatment outcomes.

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Fig. 1. Patient care pathway at the interdisciplinary spasticity management clinic.

METHODS

Study design

This was a retrospective chart review. Ethical and institutional approval were obtained from the University of British Columbia Research Ethics Board and the Vancouver Coastal Health Research Institute in accordance with requirements.

Patients

The study included 225 adult patients with spasticity between 2010 and 2013. All patients who presented for initial consultation and returned for a subsequent follow-up appointment were included.

Clinic protocol

The clinic consists of an interdisciplinary team: a physiatrist, a registered nurse, an occupational therapist and a physiotherapist. Patients are assessed by the interdisciplinary team where patient history is obtained from the patient and/or caregiver(s). A focused physical examination is performed to assess spasticity, including range of motion (ROM) and the Modified Ashworth Scale (MAS). At the initial consultation, goals of treatment are discussed and set in accordance with the SMART principle and recorded on the clinic template (Appendix 1). The goal scoring scheme is set *a priori* in collaboration with the patient and/or caregiver specifically predetermining what will be considered goal achievement (a score of 0), a better or much better than expected outcome (+1 and +2, respectively), no change (–1) or a worse than expected outcome (–2). Treatment strategies are implemented and can include occupational and physical therapies, orthoses, oral medications, and focal chemodenervation with BoNT and/or phenol. Patients then return for follow-up when GAS scoring occurs and is recorded in the chart (Fig. 1).

Goal Attainment Scale

The GAS is utilized in the clinic according to the method outlined by Turner-Stokes (5). A worked example is presented in Table I. The individual goal scores are incorporated into a single aggregate T-score using the following equation:

$$\text{Overall GAS} = 50 + \frac{10\Sigma(W_i X_i)}{\sqrt{(0.7\Sigma W_i^2 + 0.3(\Sigma W_i)^2)}}$$

where W_i represents the weight attributed to the goal. For our purposes, all goals were weighted equally, such that W=1. X_i represents the numerical goal score (–2 to +2). A T-score with a mean of 50 and standard deviation of 10 indicates that goals are being set with appropriate difficulty. A T-score well above 50 indicates that the set goals are too easy, and well below 50 implies that goals are too difficult.

Chart review

All patients presenting to clinic between 2010 and 2013 were identified using the hospital's electronic medical record (EMR). The paper charts of the 225 eligible patients were obtained and data were abstracted retrospectively using the Global Research Platform, which is a tool created by the Rick Hansen Institute. Demographic information, treatment prescribed or administered, goals, and scoring were abstracted from the paper charts at 2 time-points: the initial consultation where treatment was implemented, and the follow-up appointment when goals were scored. Goals were coded based on the relevant International Classification of Functioning, Disability and Health (ICF) domain: activity, body structure and function, and participation (7). Activity-based goals were further broken down into active vs passive goals. An example of an "active" goal is to improve gait velocity. A "passive" goal might be to improve the ease of perineal hygiene by a caregiver. Other examples of goals based on ICF domain include "increasing elbow range of motion by 45 degrees" as a structure & function goal, and "going to the swimming pool with family" as a participation goal.

Missing information was obtained from the dictated consultation notes, available through the hospital EMR. In the event of conflicting scores, the lower score was recorded in order to reduce the risk of overestimated treatment outcomes.

Statistical analysis

We tested for differences in overall T-scores by fitting a normal linear model to the data, with age, sex, and diagnosis as covariates. Significance was determined at the 0.05 level (2-sided). Differences in T-scores between domains were evaluated using a generalized estimating equation (GEE) with the patient as the cluster, to account for patients with multiple goals in differing domains. Testing for associations between GAS, age and diagnosis is approximate in the case of the χ^2 test, as the assumption of independence between goals was not met for those patients with multiple goals, and some categories had fewer than 5 patients in each cell. Fisher's exact test was used to determine association between GAS and sex, but the assumption of independent goals was still unmet.

Table I. Worked example of goal setting. Examples of goal setting using the Goal Attainment Scale (GAS) by International Classification of Functioning, Disability and (ICF) domain (active activity, passive activity, body structure & function, participation)

Goal	ICF domain	Upper-/lower-/ whole- body goal	GAS score –2 (outcome worse than expected)	GAS score –1 (baseline/no change)	GAS score 0 (goal achieved)	GAS score +1 (outcome better than expected)	GAS score +2 (outcome much better than expected)
Gait	Active activity	Lower body	Require a cane	Walk 5 m unassisted	Walk 10 m unassisted	Walk 15 m unassisted	Walk 20 m unassisted
Ease of dressing for caregiver	Passive activity	Whole body	Difficulty 9/10	Difficulty 8/10	Difficulty 4/10	Difficulty 3/10	Difficulty 2/10
Shoulder pain	Body Structure & Function	Upper body	Pain 7/10	Pain 6/10	Pain 3/10	Pain 2/10	Pain 1/10
Attend pool-based swim programme	Participation	Whole body	Participate for 0 min	Participate for 5 min	Participate for 15 min	Participate for 20 min	Participate for 25 min

Table II. Demographic data

Variable	Value
Age at visit, min/median (mean)/max	19/49 (47.8)/87
Age at onset, min/median (mean)/max	0/30.5 (30.2)/86
Number of comorbidities, min/median (mean)/max	0/3 (3)/12
Sex, *n* (%)	
Female	113 (50.2)
Male	112 (49.8)
Referral source *n* (%)	
GP	81 (36)
OT	4 (1.8)
Other	30 (13.3)
PT	11 (4.9)
RN	2 (0.9)
Specialist	97 (43.1)
Diagnosis *n* (%)	
ABI	32 (14.2)
CP	46 (20.4)
MS	28 (12.4)
Other	34 (15.1)
SCI	14 (6.2)
Stroke	71 (31.6)
Total	225

GP: general practitioner; OT: occupational therapist; PT: physiotherapist; RN: registered nurse; ABI: acquired brain injury; CP: cerebral palsy; MS: multiple sclerosis; SCI: spinal cord injury.

RESULTS

Demographics

Patient demographics and clinical characteristics are shown in Table II. The study group included male and female patients in roughly equal distributions. The mean age at clinic presentation was 47.8 years. Most patients were referred by a specialist, followed closely by a general practitioner. The most common aetiology of spasticity was stroke.

Overall T-score

A total of 431 goals were identified amongst the 225 patients. The overall T-score for the clinic was 47.7 (7.8).

T-score by diagnosis

T-scores were calculated by diagnosis. There were no significant differences seen in overall T-scores by diagnosis (Fig. 2).

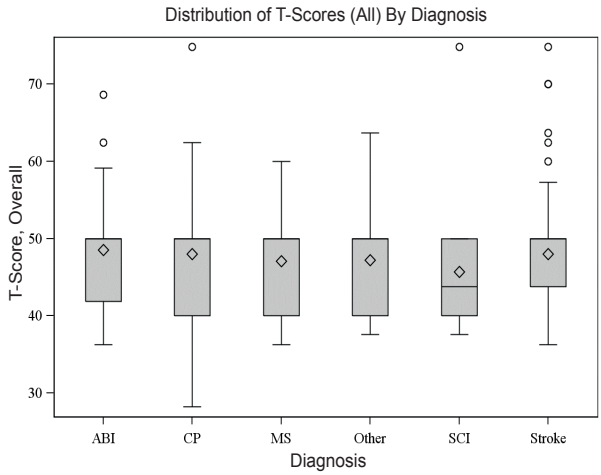

Fig. 2. Mean overall T-score by diagnosis; the diamond represents the mean.

T-score by domain

T-scores were evaluated based on the ICF domain – body structure and function, activity (active or passive), and participation. The mean T-score for passive activity goals was 47.3 (6.5), active activity goals 48.1 (8), participation goals 48.6 (10.7), and structure & function goals 48.6 (8.1). There were no significant differences in T-scores based on goal domain (smallest p-value = 0.25). Table III shows the breakdown of T-scores by diagnosis and domain.

T-score by location

Goals were categorized as upper-body, lower-body or whole-body goals. Examples include "reduce shoulder pain" as an upper-body goal, "improve heel contact in the stance phase of gait" as a lower-body goal and "reduce spasms" as a whole-body goal. Most patients had at least one lower-body goal (148), followed by at least one upper-body goal (90) and at least one whole-body goal (31). The mean T-score was 47.7 (7.7) for lower-body goals, 48.8 (7.8) for upper-body goals and 44.4 (8.2) for whole-body goals. Both upper-body and lower-body T-scores were significantly different

Table III. Mean T-score by diagnosis and International Classification of Functioning, Disability and (ICF) domain

Diagnosis	Overall T-score Mean (SD)/*n*	Structure T-score Mean (SD)/*n*	Participation T-score Mean (SD)/*n*	Passive T-score Mean (SD)/*n*	Active T-score Mean (SD)/*n*
ABI	48.5 (7.4)/32	49.8 (8.2)/21	No Patients	45.5 (5.6)/12	51.2 (7)/17
CP	48 (8.6)/46	49.3 (9.6)/32	50 (0)/3	45.6 (7.2)/20	50.8 (9)/13
MS	47.1 (6.9)/28	49 (8.1)/17	40 (.)/ 1	48.2 (4.7)/7	45.5 (7.7)/17
Other	47.2 (7.7)/34	48.8 (7.4)/17	No Patients	60 (10)/3	46.6 (7.1)/24
SCI	45.7 (9.3)/14	44.9 (5) | 11	40 (.)/ 1	40 (.)/ 1	48.1 (11.9)/8
Stroke	48 (7.6)/71	48.3 (8)/54	55 (21.2)/2	48.2 (4.4)/22	47.9 (7.7)/35
All	47.7 (7.8)/225	48.6 (8.1)/152	48.6 (10.7)/7	47.3 (6.5)/65	48.1 (8)/114

ABI: acquired brain injury; CP: cerebral palsy; MS: multiple sclerosis; SCI: spinal cord injury; SD: standard deviation.

from whole-body T-scores ($p=0.01$ and $p=0.03$, respectively).

GAS scores by diagnosis, age and sex

The majority of patients across all diagnoses met or surpassed their goals (i.e. scored 0, +1 or +2) (Fig. 3). The *p*-value for the association between diagnosis and GAS score was 0.02; however, an association between the 2 is unlikely given the small sample sizes in certain categories, the non-independence of each GAS score, and the fact that multiple goals coming from the same individual were not corrected for.

More than 60% of goals set by patients were met or surpassed regardless of age. However, there was an association between age and GAS score, with patients older than 70 years being more likely to meet or exceed their goals ($p=0.03$) (Fig. 3 (b)).

Using Fisher's exact test, there was no association between sex and GAS scoring ($p=0.13$).

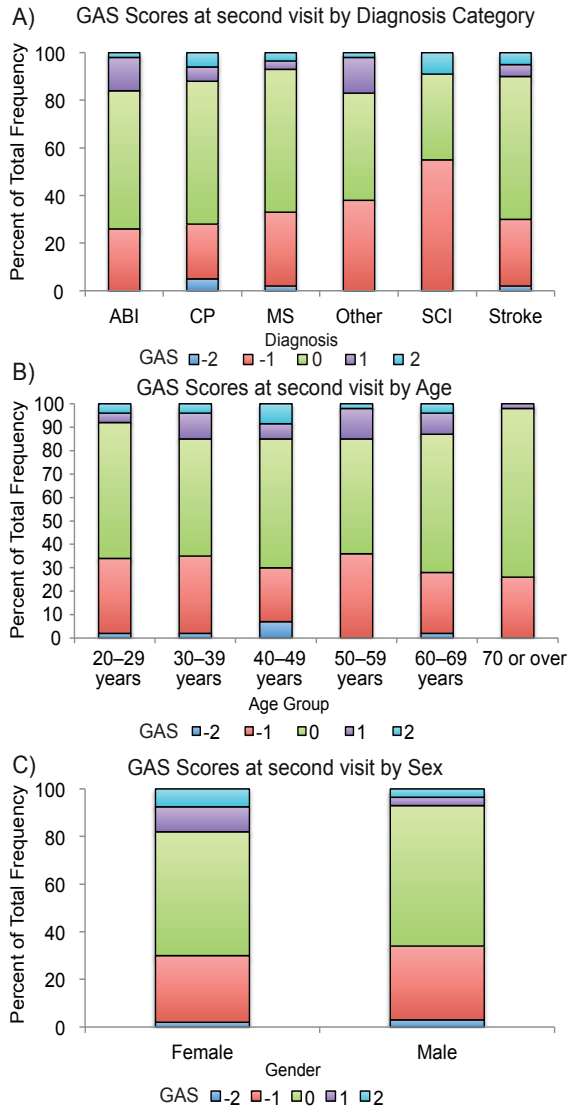

Fig. 3. Goal Attainment Scale (GAS) score by: (A) diagnosis, (B) age and (C) sex on the second visit. Red, green and brown represent meeting the goal (0) or better than expected goal (+1 or +2). Blue and purple represent no change (−1) or a worse outcome (−2).

Site of botulinum toxin injections

The most common site of injection was lower body (35.56%), followed by upper body (24.44%), then both upper and lower body (15.11%). The proportion of patients who did not receive BoNT as part of their treatment plan was 24.89%.

T-score by botulinum toxin injection site

Patients who received BoNT, whether it be to the upper body, lower body or upper and lower body, had significantly higher T-scores than the patients who did not receive BoNT injections ($p<0.01$) (Fig. 4).

DISCUSSION

Goals are being set appropriately

The overall T-score for the clinic of 47.7 fell well within the suggested standard deviation of 10; a mean of approximately 50 (4). This indicates that it was feasible to set goals appropriately within our interdisciplinary clinic. Goals were, on average, neither too easily achievable nor too difficult.

Patients are likely to meet their goals regardless of age, sex or diagnosis

Patient factors, such as age, sex and diagnosis, did not influence goal achievement. This suggests that general

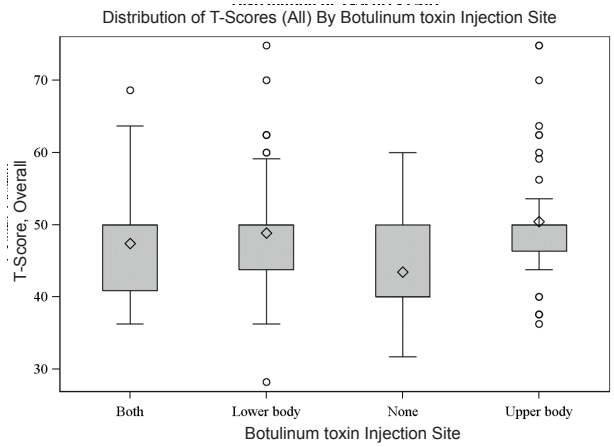

Fig. 4. T-score by botulinum toxin injection site. T-score by botulinum toxin injection site (both upper and lower body, upper body alone, lower body alone, or no injection).

practitioners and specialists, the most common sources of referrals, can expect similar results regardless of patient age, sex or diagnosis.

These results provide support for the role of the interdisciplinary spasticity management clinic across diverse patient populations, which is important, as the bulk of the recent spasticity literature on treatment with BoNT has been focused on the stroke population.

There was an association between GAS achievement and older age, where patients over the age of 70 years were more likely to meet or exceed their goal, highlighting the fact that elderly patients should also be considered for treatment. They are at least as likely as younger patients to achieve or surpass their goals. This may reflect more conservative goal setting in this age group, although the data are lacking to be more definitive. This may be a focus of further research.

Although it was not statistically significant, there was a trend for the SCI population to not achieve their goals as well as other patient groups. In the subset of patients with SCI, there was a lower T-Score (45.7) and a greater proportion of goals not met (–1 or –2). Over 50% of the SCI group had a GAS < 0. There are several possible explanations for this trend. It may reflect a different pattern of spasticity in people with SCI, perhaps due to the more widespread nature as opposed to the more focal spasticity often seen in stroke. Alternatively, it could represent a subset of the SCI population with spasticity refractive to treatment, whereas the majority of SCI patients in our region are treated adequately by a tertiary care physiatrist and are not referred to a quarternary care spasticity clinic.

A focus of future research could be to identify other patient factors that predict spasticity treatment success or failure. Treatment naivety, time from the onset of the underlying diagnosis, and severity of spasticity are future characteristics to analyse.

Patients are likely to meet their goals regardless of goal domain

Goal characteristics, such as ICF domain or body location, did not influence goal achievement. Previous studies in stroke patients have shown that spasticity treatment with BoNT was only effective for upper limb passive goals (8). BoNT treatments directed towards the active goal of gait have long been used in the paediatric cerebral palsy population (9). A 2010 meta-analysis showed a small, but significant, increase in gait velocity with BoNT for lower extremity spasticity in adults post-stroke (10). Our study has provided practice-based evidence that patients can expect to achieve active goals if the goals are appropriately set.

Patients with focal spasticity may see better results

Treatment strategies directed at upper-body or lower-body goals were more effective than those directed at whole-body goals. This may reflect that generalized spasticity can be more difficult to treat than focal spasticity, and would be in keeping with the trend for the SCI group to do less well.

Botulinum toxin injections may improve outcomes in the short term

BoNT was employed as a treatment strategy in 75% of patients. The lower body was the most frequently injected site. GAS T-scores were significantly higher in those who were treated with BoNT, regardless of site of injection, compared with the 25% of patients who did not receive injections. There are some caveats that lead us to approach this conclusion cautiously. BoNT has a maximum peak effect at 4–6 weeks, whereas treatment strategies such as physiotherapy interventions may be equally effective but require more time to see their maximum effects. One of the limitations of this study is the fact that GAS outcomes were only assessed at a single follow-up time-point. Future studies should re-assess outcomes at multiple standardized time-points.

We do not suggest that treatment success is attributable solely to BoNT injections. The guiding principle of an interdisciplinary clinic is that multiple treatment modalities should be considered and prescribed appropriately, often in combination, in an attempt to optimize patient outcomes and goal achievement. We rarely treat spasticity with BoNT chemodenervation in isolation. A stretching and/or exercise programme, bracing, and other modalities (electrical stimulation, taping, etc.) are almost always prescribed in combination with BoNT injections. This is in keeping with recommended guidelines and must be considered when interpreting our results (11, 12). This may explain why we found that patient goals related to active function in both the upper and lower body were met, whereas some previous studies of BoNT alone did not have similar results.

Limitations

Limitations of this study include those inherent to any retrospective chart review, i.e. incomplete data entries and conflicting reports. In the event of incomplete data, a review of the paper chart was performed. When goal scoring conflicted between the patient and the treating team, the patient's score was used.

The study was also limited by small sample sizes in certain groups for subanalyses. There were only 14

subjects in our SCI group for subanalysis by diagnosis. Similarly, only 7 goals were in the participation ICF domain.

Patients were not followed up at the same time interval as this was not practically feasible. Ideally, all patients would be seen at the 4–6 week mark to capture the maximum effect of the BoNT. We were reliant on patients' subjective experience, which corresponds with the patient-centric nature of the GAS. Confounders that may underestimate the success of the clinic overall include patients who were ill, such as having a urinary tract infection at the time of their follow-up appointment that increased their spasticity, or non-compliance with treatment suggestions, such as a daily home stretching programme. Conversely, confounders that may over-estimate the success of the clinic include patients who were ill at the time of initial assessment, thereby overestimating the treatment effect at follow-up. Also, surgical interventions, such as a tendon release, would lead to improvements on GAS not due to an intervention implemented directly by the clinic, as was the case with one patient.

Conclusion

We have demonstrated that it is feasible to generate practice-based research evidence of interdisciplinary spasticity treatment outcomes in a busy clinical setting using the GAS. Application of the GAS enabled successful goal-setting and measurement of goal achievement. Our practice-based research shows that referring clinicians, patients, and caregivers can reasonably expect a successful outcome regardless of patient factors, such as age, sex or diagnosis, or goal characteristic, such as ICF domain or body location. BoNT treatment in this setting was associated with improved goal attainment, at least in the short term, for both upper and lower limb spasticity relating to multiple ICF domains.

The authors declare no conflicts of interest.

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Appendix 1. The clinical template used in this study

GF Strong Rehab Centre

INTERDISCIPLINARY SPASTICITY MANAGEMENT SERVICE

PCIS LABEL

INITIAL VISIT

Date: _____ **Date referred:** _____ **# Weeks since referral:** _____

Referral source: ☐ GP ☐ Specialist ☐ PT ☐ OT ☐ RN ☐ Other: _____

Residence: ☐ Home ☐ Home with supports ☐ LTC facility ☐ Hospital ☐ Other: _____

Diagnosis: ☐ Stroke ☐ ABI ☐ SCI ☐ MS ☐ CP ☐ Other: _____

Date of onset: _____

Funding source: ☐ Pharmacare ☐ WSBC ☐ ICBC ☐ Private Insurer ☐ None

Reason for referral:

☐ Decrease pain ☐ Improve dressing ☐ Improve hygiene ☐ Improve gait ☐ Improve UE function ☐ Improve seating

☐ Improve transfers ☐ Prevent contractures ☐ Improve orthotic fit ☐ Cosmesis ☐ General spasticity management

☐ Other: _____

Spasticity Issues / Triggers:

Past Medical History:

Medications:

Social History:

Occupation:

Lives with: ☐ Alone ☐ Spouse ☐ Family ☐ Facility

Home care # hours/day:

Homecare # days/week:

Equipment:

Allergies:

Previous spasticity treatment and response:

☐ PT/OT:	☐ Never ☐ Past ☐ Current	Stretching	Splinting	Equipment	Home care	Other	
☐ Oral meds:	☐ Never ☐ Past ☐ Current	Baclofen	Tizanidine	Gabapentin	Cannabinoids	Other	
☐ BTX:	☐ Never ☐ Past ☐ Current	Mucles	Dose	When	How many times		
☐ Phenol:	☐ Never ☐ Past ☐ Current	Muscles	Dose	When	How many times		
☐ ITB:	☐ Never ☐ Past ☐ Current						

VCH.VA.GFS.0022 I FEB.2013

Initials: _____

Appendix 1. *cont.*

	Right			Left			BTX dose	Right	Left
Muscle group	**Power**	**MAS**	**R1/R2**	**Power**	**MAS**	**R1/R2**	Pec maj		
Shoulder add							Lats		
Shoulder IR							Ter maj		
Elbow flex							Subscap		
Elbow ext							Biceps		
Pronators							BRad		
Supinators							Brach		
Wrist flex							FCR		
Finger flex- FDS							FCU		
Finger flex- FDP							PT		
Lumbricals							PQ		
Thumb flex							FDS		
Hip flex							FDP		
Hip ext							Lumbricals		
Hip add							FPL		
Hip IR							FPB		
Hip ER							Opp Poll		
Knee flex							Add Poll		
Knee ext							Iliopsoas		
Ankle DF							Rect Fem		
Ankle PF							Vast Lat		
Ankle Inv							Vast Med		
Ankle Ev							Adductors		
Toe flex							Sartorius		
Toe ext							SemiM/T		
Other:							Bic Fem		
							Gastroc		
							Soleus		
							Tib Post		
							Tib Ant		
							FDL		
							FHL		
							FDB		
							FHB		
							Other:		
							TOTAL		

Gait ☐ Normal ☐ Abnormal ☐ Not assessed

UE function ☐ Normal ☐ Abnormal ☐ Not assessed

Skin ☐ Normal ☐ Abnormal ☐ Not assessed

Details:

Initials: _____

DATE: _____

SEEN BY: ☐ MD ☐ PT ☐ OT ☐ RN

Problem	Goal	GAS-2-10+1 +2		
		Pt	Carer	HCP
☐ ↓ROM				
☐ Dressing				
☐ Feeding				
☐ Hygiene				
☐ Toileting				
☐ Transfers				
☐ Mobility				
☐ Splinting				
☐ Cosmesis				
☐ Pain NRS	NRS			
☐ Other				

Treatment Plan:

☐ PT ☐ OT ☐ Splint ☐ Oral Meds ☐ BTX ☐ Phenol ☐ ITB ☐ Other

Follow-up Plan: Person responsible:

1.

2.

3.