The North West London Hospitals
NHS Trust

Goal Attainment Scaling (GAS) in Rehabilitation

A practical guide

Further information and advice may be obtained from:

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Background

Measuring effectiveness of brain injury rehabilitation poses major problems due to the heterogeneity of patients' deficits and desired outcomes. Particularly at the level of handicap (participation), goals are very much dependent on the individual's lifestyle and aspirations and standardised measures become increasingly difficult to apply.

> *For example, for some patients being able to move about independently in a wheelchair may be a triumph, while for others this would mean failure.*

Goal-setting has become a routine part of rehabilitation and many multi-disciplinary approaches to clinical care. There is substantial literature which demonstrates its usefulness, both as part of the communication and decision-making process, and as a person-centred outcome measure for rehabilitation(1).

Goal attainment scaling (GAS)

Measurement through GAS was first introduced in the 1960s by Kirusek and Sherman(2) for assessing outcomes in mental health settings. Since then it has been modified and applied in many other areas including:

- Elderly care settings(3, 4)
- Chronic pain(5)
- Cognitive rehabilitation(6)
- Amputee rehabilitation(7)

GAS offers a number of potential advantages as an outcome measure for rehabilitation.
As goal-setting is already a part of routine clinical practice in many centres, it builds on this already established process to encourage:

- **communication and collaboration** and between the multi-disciplinary team members as they meet together for goal-setting and scoring
- **patient involvement** - there is emerging evidence that goals are more likely to be achieved if patients are involved in setting them. Moreover, there is also evidence that GAS has positive therapeutic value in encouraging the patients to reach their goals(5)

In particular, the more formalised process of 'a priori' goal setting and defining and agreeing expected levels of achievement with the patient and their family supports the sharing of information at an early stage of rehabilitation and the negotiation of realistic goals.

As an outcome measure, there is growing evidence for the sensitivity of GAS over standard measures(8, 9). It potentially avoids some of the problems of standardised measures including:

- Floor and ceiling effects
- Lack of sensitivity – particularly of global measures, where individuals make change in one or two important items but this change is lost in the overall scores, where a large number of irrelevant items do not change.

The literature encompasses a range of different approaches to GAS, the procedure described below is based on that used in the context of upper limb spasticity by Ashford and Turner Stokes(10). It represents an attempt to establish a more consistent approach.

Goal attainment scaling (GAS)

What is GAS?

GAS is a method of scoring the extent to which patient's individual goals are achieved in the course of intervention. In effect, each patient has their own outcome measure but this is scored in a standardised way as to allow statistical analysis.

Traditional standardised measures include a standard set of tasks (items) each rated on a standard level. In GAS, tasks are individually identified to suit the patient, and the levels are individually set around their current and expected levels of performance.

How is GAS rated?

An important feature of GAS is the '*a priori* ' establishment of criteria for a 'successful' outcome in that individual, which is agreed with the patient and family before intervention starts so that everyone has a realistic expectation of what is likely to be achieved, and agrees that this would be worth striving for. Each goal is rated on a 5-point scale, with the degree of attainment captured for each goal area:

If the patient ***achieves*** the expected level, this is scored at ***0***.
If they achieve a ***better*** than expected outcome this is scored at:
+1 (somewhat better)
+2 (much better)
If they achieve a ***worse*** than expected outcome this is scored at:
-1 (somewhat worse) or
-2 (much worse)

Goals may be weighted to take account of the relative importance of the goal to the individual, and/or the anticipated difficulty of achieving it.

How is the overall GAS score calculated?

Normally 3-4 goals are identified, which are incorporated into the single GAS score.

Overall Goal Attainment Scores are then calculated by applying a formula:

$$\text{Overall GAS} = 50 + \frac{10\,\Sigma(w_i\,\underline{x}_i)}{[(1-\rho)\,\Sigma w_i^2 + \rho(\,\Sigma(w_i)^2]^{\,1/2}}$$

Where:
w_i = the weight assigned to the *i*th goal (if equal weights, $w_i = 1$)
$\underline{x}_i$ = the numerical value achieved (between –2 and + 2)
ρ = the expected correlation of the goal scales

For practical purposes, according to Kirusek and Sherman, ρ most commonly approximates to 0.3, so the equation simplifies to:

$$\text{Overall GAS} = 50 + \frac{10\,\Sigma(w_i\,\underline{x}_i)}{\sqrt{(0.7\,\Sigma w_i^2 + 0.3(\Sigma w_i)^2)}}$$

(NB: Mathematically challenged readers take heart – there are calculation tables in the book by Kiresuk(11)- alternatively a simple spreadsheet calculator is available from the author!)

In effect, therefore the composite GAS (the sum of the attainment levels x the relative weights for each goal) is transformed into a standardised measure or T score with a mean of 50 and standard deviation of 10.

If goals are set in an unbiased fashion so that results exceed and fall short of expectations in roughly equal proportions, over a sufficiently large number of patients, one would expect a normal distribution of scores and the GAS thus performs at interval level. Demonstrating that the mean GAS for the study population is around 50 is a useful quality check of GAS scoring. If a team attempts to inflate their results by scoring over-cautiously, the mean score will be >50. Similarly, if they are consistently over ambitious it will be <50.

Procedure for Goal Attainment Scoring

1. Identify the goals

Interview the patient to identify the main problem areas and establish an agreed set of priority goal areas (with the help of the team) for achievement by an agreed date (usually discharge or the end of the programme). Set goals should follow the SMART principle – that is, they should be Specific, Measurable, Attainable, Realistic and Timely.

2. Weight the goals

Assign a weight to each goal using the table below.

Weight = importance x difficulty

Importance and difficulty may each be rated on a 4 point scale

Importance	**Difficulty**
0 = not at all (important)	0 = not at all (difficult)
1 = a little (important)	1 = a little (difficult)
2 = moderately (important)	2 = moderately (difficult)
3 = very (important)	3 = very (difficult)

In effect though, if the goal is 'not at all' important it will not be selected, and if 'not at all' difficult it has presumably already been achieved, so that in effect these resolve to 3-point scales. If a weighting system is not used, a value of '1' is simply applied to weight in the formula.

3. Define expected outcome

The 'expected outcome' is the most probably result if the patient receives the expected treatment. Define also the levels for

- 'somewhat less' and 'much less'
- 'somewhat more' and 'much more'

These are defined by the team or investigator, and should be ***as objective and observable as possible.*** This process also provides an opportunity to negotiate with the patient if they have unrealistic expectations. For example if the patient wants active hand function, but realistically using the affected hand as a prop is the expected outcome, then the active function task can be set at level 2, and use as a prop at level 0. This way, the patient's aims are not dismissed, but are clearly defined as beyond the level of expectation.

4. Score baseline

This is usually rated –1, unless the patient is as bad as they could be in that particular goal area, in which case the baseline rate is –2.
Using this baseline score as a substitute for "attainment level" in the equation described earlier, a baseline Goal score can be calculated.

5. Goal Attainment scoring

Rate the outcome scores at the appointed review date.
Calculate the GAS T score by applying the formula or, with the use of published tables(11), look up the summated scores. A simple spreadsheet calculator is available.
Technically the GAS T score is, in itself a measure of change, but in certain circumstances it may be appropriate to record the change in GAS score, which is determined by subtracting the baseline GAS rating (see Section 4) from the outcome GAS rating. In practice, however, the change in GAS score usually correlates closely with the T score, and offers little further advantage

Some practical tips for making GAS easier for routine practice.

Many teams have reported that applying GAS in the way originally described by Kirusek is excessively time-consuming for routine clinical use. On the Regional Rehabilitation Unit at Northwick Park Hospital, we have successfully introduced GAS in our everyday clinical practice, by reducing some of the more time-consuming steps, which others may find helpful.

1. 'Objective' setting

In our unit, a set of defined 'objectives' is agreed with the patient to be achieved during the programme or admission, and then 'staged goals' towards these objectives are set and reviewed at fortnightly intervals. GAS is not applied to every staged goal, but just to the 3-4 key objectives that are agreed as the most important to the patient. Baseline rating is undertaken before injection and the outcome level of achievement is rated just once at the team review date - 3-4 months after injection.

2. Wording of goals

Wording of goals can be time-consuming. Some goals occur very commonly. Over time we have developed a menu of pre-worded goal statements in these more common areas that may be chosen or adapted, to save starting from scratch with each new patient. Having said that, we try to encourage the patient to identify personal goals which are not simply based on standard outcomes that are recorded in our routine standardised measures.

3. Weighting

Although weighting for 'importance' has a consistent effect on overall GAS scores in the expected direction, weighting for 'difficulty' can, in some circumstances, lead to a perverse bias. Overall, weighting does not make a big difference to the overall GAS scores, and the weighted and unweighted scores are very closely correlated. So while importance and difficulty may be useful to record for qualitative interpretation, it is perfectly adequate to use unweighted scores in the GAS calculation (ie a weighting of 1 throughout).

4. Attainment score levels

Applying the method originally recommended by Kiresuk and Sherman, pre-determined levels should be defined for each of the five outcome score levels (-2, -1, 0, +1 and +2). This is very time-consuming, when ultimately only one level will be used. In routine clinical

practice on our unit, we concentrate on defining very carefully the expected 'level 0' outcome at baseline. Then, at the end of the programme, it is quite easy for the team and patient to agree whether this level was achieved (0); if it was slightly exceeded (+1) or greatly exceeded (+2); or if it was 'not quite achieved' (-1) or 'nowhere near' (-2).

Preliminary evaluation against the more detailed definitions suggested that this method provided acceptable accuracy (86-92%) and saved a lot of time. For clinical purposes, we believe this is adequate. However, when using GAS for research it we would still recommend the full a priori goal-setting to ensure due rigour.

5. GAS calculation

We have also developed an electronic GAS calculation sheet, written in Microsoft Excel which automatically calculates The Baseline, achieved and GA change scores when the scores are added. This is freely available for download on our website
http://www.kcl.ac.uk/lsm/research/divisions/cicelysaunders/resources/tools/gas.aspx

Building GAS into clinical thinking – the GAS-light model

This guide has described the detailed application of GAS as an outcome measure. However, as goal setting increasingly becomes embedded into clinical thinking, it is possible to streamline the process further using the shortcuts described above. Appendix 2 describes the use of this 'GAS-light' model in the context of treatment of upper limb spasticity with botulinum toxin.

Summary

GAS therefore depends on two things – the patient's ability to achieve their goals and the clinician's ability to predict outcome, which requires knowledge and experience. Some people may find this challenging, but we believe that if a clinician is providing an intervention, they should have some idea about the likely outcome, and using GAS has helped us to develop our skills in outcome prediction. It is not necessary to be right all of the time – so long as goals and over and under-achieved on a more or less equal basis. As noted above, the demonstration of a mean T score around 50 provides feedback relating to the accuracy of our goal-setting.

GAS is conceptually different from standardised measures – if interval measures may be described as measuring with 'a straight ruler', and ordinal measures as 'a piece of string', then GAS is the equivalent of measuring with a piece of elastic. Many clinicians reared in the tradition of rigorous and objective measurement struggle with this concept.

Standardised measures still provide a useful yard stick for comparing different populations of patients on a level platform and it is NOT suggested that GAS should replace them. However, it does provide a useful reflection of outcomes that are of critical importance to the patient in the context of their own lives, which is something not provided by traditional measures. For this reason we recommend that GAS and standardised measures are used side by side.

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Appendix 1: Worked example

Patient AB was referred for rehabilitation following a stroke
Her goals for treatment are

- to reduce her shoulder pain,
- to improve independence in dressing and
- to improve her gait pattern.

	At baseline	Expected outcome
1. Reducing shoulder pain	She had severe shoulder pain rating 8/10 at rest, disturbing her sleep and waking her 2-3 times a night	We expected to reduce her pain to around 4/10, and to reduce night time waking through pain to once a night
2.Ease of dressing	She needed help to dress her upper body	We expected that she would be able to dress her upper body unaided
3. Able to drive	She was unable to drive	We expected that she would be able to return to driving using an adapted car

Weighting and baseline scores
Her weighting and goal scores are shown in the table below.
All goals were rated as 'moderately difficult' and she rated pain reduction as very important.
Her baseline score for each of the three goals was –1.

See follow-up guide for evaluating outcome.
Notice that goal 1 has been split into two goals – one reflecting pain levels (as rated on a Visual analogue scale) and the other reflecting night time disturbance through pain

Goal	Importance*	Difficulty	Weight (IxD)	Baseline score	Outcome score
1a) Pain level	3	2	6	-1	+1
1b) Waking	3	2	6	-1	0
Ease of dressing	2	2	4	-1	0
Driving	1	2	2	-1	-1
			Sum = 18		

Outcome
At her outcome review, her pain had completely resolved so she scored +2, since the outcome could not have been any better. She was able to dress herself independently. (Score 0).
Although she had had a successful driving assessment she was still waiting for her adapted car to arrive and so was not driving at the point of discharge (-1).

	Achieved outcome
1. Reducing shoulder pain	Her pain had reduced substantially to VAS scores of 2 at rest and 3 on movement (Score +1), so that she was now only waking once a night due to discomfort (Score 0)

* Although in this example the goals appear to be ranked in importance, importance is rated independently for each goal. She could therefore have rated all goals as 2 or 3 if she had wished.

2.Ease of dressing	She achieved her goal of being able to dress her upper body without help, although this took some time (Score 0)
3. Driving	Although she had had a successful driving assessment she was still waiting for her adapted car to arrive and so was not driving at the point of discharge – she therefore scored -1, even though this was beyond our control

Applying the formula:

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

Starting with: $\sqrt{(0.7\,\Sigma w_i^2 + 0.3(\Sigma w_i)^2)}$ we have:

$\sqrt{(0.7(36+36+16+4) + 0.3(324))}$
$= \sqrt{(64.4 + 97.2)}$
$= 12.7$

Then applying the full formula:

The baseline GAS is $50 + \frac{10 \times (-18)}{12.7} = 50 + (-180 / 12.7) = 50 - 14.2 = 35.8$

The outcome GAS is $50 + \frac{10 \times (+4)}{12.7} = 50 + (40 / 12.7) = 50 + 3.1 = 53.1$

(The change in GAS score, should one wish to measure it, is therefore 17.3)

In this particular case, GAS confirms a better than expected result, but please note, not all cases will be as positive as this.

Alternatively applying the formula without weighting (all weights = 1)

$\sqrt{(0.7(1+1+1+1) + 0.3(16))}$
$= \sqrt{(2.8+ 0.4.8)}$
$= 2.75$

The baseline GAS is $50 + \frac{10 \times (-4)}{2.75} = 50 + (-40 / 2.8) = 50 - 14.5 = 35.5$

The outcome GAS is $50 + \frac{10 \times (0)}{2.8} = 50 + 0 = 50 = 50$

(The change in GAS score, should one wish to measure it, is therefore 14.5)

Goal Attainment Scaling: Prof Lynne Turner Stokes.

Follow-up guide:

Goal	-2	-1	0	+1	+2
1a. Reducing shoulder pain	Pain scores 9-10/10 overall	Pain scores 7-8/10 Overall **Baseline ✓**	Pain scores 4-5/10 overall	Pain scores 2-3/10 overall **Outcome ✓**	Pain scores 0-1/10 overall
1b. Reduce night time waking due to pain	Night time waking due to pain 4 or more times a night	Night time waking due to pain 2-3 times a night **Baseline ✓**	Night time waking due to pain only once a night **Outcome ✓**	Night time waking due to pain occasionally but not every night	No night time waking due to pain
2.Ease of dressing	Unable to don cardigan at all	Requires help to dress her upper body (don cardigan) **Baseline ✓**	Able to dress her upper body (don cardigan) unaided albeit slowly **Outcome ✓**	Able to dress her upper body (don cardigan) in near-normal time	Able to complete all upper body dressing tasks independently and in normal time
3. Driving	Unable to drive, and this is confirmed not to be a future option open to her	Unable to drive, but this may be possible when she has been assessed for driving ability and need for adaptations **Baseline ✓** **Outcome ✓**	Able to drive using an adapted car, but not necessarily using this as her normal means of transport yet	Able to drive using an adapted car, but limited distances only	Able to drive unlimited distances

Appendix 2: The "GAS – light" model

Background:

Goal setting is an integral part of clinical decision-making in rehabilitation.

Goal attainment scaling (GAS) provides a flexible and responsive method of evaluating outcomes in complex interventions, but clinicians have reported a number of problems that have limit its uptake as an outcome measure for routine clinical practice:

1. The rigorous GAS methodology used in research is time-consuming
2. Clinicians are confused by the various different scoring methods reported in the literature.
3. They generally dislike applying negative scores which may be discouraging to patients, and are put off by the complex formula.

This 'GAS-light' model has been devised to help clinicians to build GAS into their clinical thinking and is described here as an aid to decision-making and outcome evaluation, taking the example of management of spasticity using botulinum toxin ± therapy (BoNT±T) in the context of routine practice.

Six key steps in decision-making and records needed to inform GAS-light

Key steps	**Clinical decision-making**	**Record**
1. What are the pt's principal presenting problems?	Which, if any, are amenable to treatment with BoNT+T?	Key **problem areas** to address: ❑ Pain ❑ Passive function (caring for limb) ❑ Active function ❑ Mobility ❑ Involuntary movement ❑ Impairment (eg range of movement)) ❑ Other:
2. What do you expect to be able to achieve with BoNT±T?	Is this likely to be worthwhile? a) to the patient b) value for money Will you offer treatment?	**If so, broadly define:** Primary goal for treatment Secondary goals (limit to 2-3 max)
3. Is the team and the pt/family agreed on the expected outcome?	If not, can use GAS 5-point scale to negotiate realistic outcome for key goal areas	**SMARTen goals** as reasonably possible: Relate to a specific function and define ▪ expected level of achievement* by ▪ intended date (usually 3-4 mths) Goal weighting** is optional, but may be useful for qualitative interpretation
4. How will outcome be assessed?	Decide which, if any, outcome measures to use.	**Baseline** values of chosen measures eg ▪ Baseline GAS scores for each goal ▪ spasticity – Modified Ashworth Scale ▪ goal-related parameters*
5. Plan treatment	Decide what muscles to inject Make arrangements for therapy and follow-up review	Record procedure: ▪ muscles injected, agent and doses ▪ use of EMG/stimulation
6. Review	Have the goals been achieved? What, if any, further treatment is necessary?	Record **level of achievement** for each goal Enter in software to derive GAS T score

*It is often helpful to use tools such as numeric or visual analogue scales to record levels of pain or ease of caring and to use these for goal setting eg to reduce from a reported pain level of 7/10 to 4/10

** Importance of goal to the patient (low, medium high) and/or goal difficulty as perceived by team (low, medium high) may be recorded if desired, but mkes little difference to the quantitative evaluation of GAS.

Using GAS to negotiate realistic goals

Although the originators of GAS recommended a priori definition of each goal level in a 'follow-up guide' this is found to be excessively time-consuming.

In the GAS-light model, clinicians are advised to concentrate on defining the expected 'level 0' outcome as SMARTly as is reasonably possible within the clinical setting. Providing that this level has been carefully documented, outcome scores may then be allocated by team agreement at the point of evaluation using the verbal rating system shown below.

However, predefinition of GAS levels can, on occasion, provide a useful tool for negotiation. For example, if a patient wants to achieve active hand function, when realistically using the affected hand as a prop is the expected outcome. In this situation, the active function task can be set at level 2, and use as a prop at level 0. This way, the patient's goal is not totally dismissed, but is clearly defined as beyond the level of expectation.

Recording GAS without numbers

Clinicians often think in terms of change from baseline.

- A problem with the 5-point GAS score is that it does not allow 'partial achievement' of a goal to be recorded of the baseline score was -1.
- On the other hand if all baseline scores are recorded at -2, this does not allow for worsening.

The following algorithm allows clinicians to record goal attainment without reference to the numeric scores, and so avoids the perceived negative connotations of zero and minus scores.

A number of scoring systems are currently being explored, including a -3 and a -0.5 option.
In the meantime, we propose that clinicians should use a 6-point verbal scale which covers all eventualities and can be computed in any of the models, providing the baseline score is known.

The **GAS-light verbal scoring system** is shown below:

				Computerisation	
At Baseline	With respect to this goal do they have?	Some function	❑	-1	
		No function (as bad as they could be)	❑		-2
At Outcome: Was the goal achieved?	**Yes**	A lot more	❑	+2	+2
		A little more	❑	+1	+1
		As expected	❑	**0**	**0**
	No	Partially achieved	❑	(-1)	-1
		No change	❑	-1	-2
		Got worse	❑	-2	

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Goal Attainment Scaling: Prof Lynne Turner Stokes.

Goal Attainment Scaling (GAS) Record Sheet

Patient Name:…… Age…… Hospital No:……

Discharge date:…… Keyworker:……

	Patient stated goal	**SMART goal**	**Imp**	**Diff**	**Baseline**	**Achieved**		**Variance** (Describe achievement if differs from expected and give reasons)
1.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	
2.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	
3.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	

Goal Attainment Scaling: Prof Lynne Turner Stokes.

Goal Attainment Scaling (GAS) Record Sheet continued

	Patient stated goal	**SMART goal**	**Imp**	**Diff**	**Baseline**	**Achieved**		**Variance** (Describe achievement if differs from expected and give reasons)
4.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	
5.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	
6.			**0** **1** **2** **3**	**0** **1** **2** **3**	❒ **Some** function ❒ **None** (as bad as can be)	❒ Yes	❒ Much better ❒ A little better ❒ **As expected**	
						❒ No	❒ Partially achieved ❒ Same as baseline ❒ Worse	

Summary

Baseline GAS T-score:	**Achieved GAS T-score**	**Change in GAS T Score**