**Supplementary File 8 Health Economics Evaluation Methods**

The perspective adopted in the trial was that of the National Health Service (NHS) and social services. Information gathered from the trial on health-related quality of life (HRQoL) and healthcare resource use data, in conjunction with NHS unit cost data, were used to examine the following:

* The cost of performing the trial interventions;
* The follow-up healthcare resource use and costs for trial participants in the three trial arms;
* Health-related quality of life (HRQoL) as assessed using the Euroqol-5 Dimensions-5 Levels (EQ-5D-5L;
* The incremental cost-effectiveness ratio (ICER) for the different interventions.

For completeness, summaries and the ICERs will be calculated for all three pairwise comparisons:

* + Supported Self-management + verum splint vs. Supported Self-management + placebo splint
  + Supported Self-management + verum splint vs. Supported Self-management
  + Supported Self-management + placebo splint vs. Supported Self-management

**Data collection**

*Quality of life*

Generic HRQoL was measured using the Euroqol-5 Dimensions-5 Levels questionnaire (EQ-5D-5L). The EQ-5D-5L asked participants to describe their health over the past 4 weeks in terms of mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Any problems with regards to these health states are reported (none, slight, moderate, severe and unable/extreme). In addition, participants were then asked to rate their health using a 100-point visual analogue scale (VAS; 0=worst health you can imagine to 100=best health you can imagine). The EQ-5D is a standardised measure of health providing a simple generic measure of health for clinical and economic appraisal.

The EQ-5D-5L was completed at baseline, 8 and 12 weeks post randomisation.

*Resource use*

As part of the NHS and social services perspective adopted we included the following health care resource use categories over the 12-week follow-up

* Resource use involved with trial procedures, including: time spent on delivering the intervention at baseline and at 4 weeks, job grade of the healthcare staff delivering the intervention, and cost of the splint.
* Follow-up hospital resource use, including: visits to accident & emergency (A&E), ambulance use, outpatient visits, day cases and length of stay in hospital including stays in an intensive treatment unit (ITU);
* Community care use, including visits to a: general practitioner (at surgery, home or through the telephone); nurse (at surgery or at home); physiotherapist; occupational therapist; psychologist; and counsellor.

Information on the splints used for each participant were recorded at the baseline intervention delivery; the staff delivering the intervention recorded the duration of intervention delivery at baseline and at 4 weeks, as well as their job grade. Where there was no evidence that participants attended their intervention delivery at either baseline or 4 weeks, they were allocated a duration of zero minutes. If they were known to have attended the appointment, but no data for the time required for the intervention delivery was available, they were allocated the median intervention delivery time for their treatment group. For one participant (self-management + verum splint group), the splint received was unknown; for the purposes of the cost-effectiveness analysis, they were assumed to have received a Procool verum splint (i.e. the more commonly used splint).

All other follow-up resource use was collected using patient questionnaires administered at 8 and 12 weeks post randomisation. In the questionnaires we did not distinguish whether the contacts with the healthcare service were through the NHS, social services or private providers, and we assumed in a bid to keep the questionnaires as simple as possible, that all contacts were financed by the NHS or social services.

*Unit costs*

The cost of the different splints was obtained from the trial team at the University of Southampton.

Unit costs for the physiotherapists or occupational therapists delivering the trial intervention, as well as consultations with GPs, nurses, psychologists and counsellors were obtained from the Unit Costs of Health and Social Care compendium for 2017/2018 [1]. For the intervention delivery, the unit costs were used to generate a cost per minute, which was then applied to the duration recorded for the intervention delivery.

For all other health service contacts, unit costs were derived from the NHS National Schedule of Reference Costs 2017 to 2018[2]. For outpatient visits, we used the weighted average of all consultant led non-admitted face to face attendances, either first or follow-up. For visits to accident and emergency (A&E), we used the weighted average of all emergency medicine contacts, excluding patient dead on arrival. For ambulance services, we used the weighted average of all ‘see and treat and refer’ and ‘see and treat and convey’ cases.

Using the reasons for hospitalisation reported by patients in the resource use questionnaires, we obtained diagnosis and procedure codes. These were then translated into a Health Resource Group (HRG) using the HRG4+ 2016/17 Reference Costs Grouper (NHS Digital). Each HRG was then linked to a series of elective, non-elective and day case reference costs obtained from the 2017/18 schedule of reference costs[52].

The unit costs used in this analysis can be seen in the **Table SF8.1**.

**Statistical analysis**

For the economic evaluation, the base case scenario adopted an available case-analysis approach (i.e. all available data was used). .

*Quality of Life*

At each follow-up, responses to each of the 5 questions in the EQ-5D-5L are presented. As recommended by National Institute for Health and Care Excellence (NICE), EQ-5D-5L responses were converted into utilities using the validated mapping function to derive utility values for the EQ-5D-5L from the existing EQ-5D-3L[34, 53].

*Quality-Adjusted Life Years (QALYs)*

Quality adjusted life years (QALY’s) are calculated for the two follow-up periods, i.e. randomisation to 8 weeks and 8 to 12 weeks. Utilities were assumed to change linearly between each follow-up time points, and QALYs were calculated using an area under the curve approach.

For each treatment group, results are reported as QALYs with 95% CIs calculated non-parametrically from 1,000 bootstrap differences. Mean QALY differences between the two patient groups were also presented with 95% CIs estimated using the 1,000 bootstrap differences. Results are presented for the whole patient sample (i.e. where patients who withdrew from the analysis were treated as censored and missing utility estimates were assumed to be the same as the mean for that treatment group).

*Resource use*

Splints received, duration of intervention delivery and all contacts with health care services over the follow-up were reported as mean per participant (S.D.). Differences between the treatment groups are generated separately at each time points based on linear regression models adjusted, in line with the main statistical model, for age at randomisation, sex, baseline AUSCAN hand pain index, baseline utility, as well as whether the treated hand is the dominant hand, accounting for clustering within sites using robust standard errors using Stata’s ‘cluster’ option. Results are then presented as means together with 95% CI, generated through 1,000 bootstrap estimates. Mean differences were also estimated as well as the 95% CI of the difference using bootstrapping.

*Costs*

Costs for the splints, intervention delivery and total resource use at each follow-up are presented as means (S.D.), with differences between the groups assessed using regression models as described above. The total costs incurred over the 12 week trial follow-up are summed up over the two follow-up periods, based. Results are then presented as means together with 95% CI, generated through 1,000 bootstrap estimates. Mean differences were also estimated as well as the 95% CI of the difference using bootstrapping.

12-week costs totals were evaluated using an available case analysis, i.e. for each treatment group, average component costs were summed up over the 12-week period. Results are then presented as means together with 95% CI, generated through 1,000 bootstrap estimates. Mean differences were also estimated as well as the 95% CI of the difference using bootstrapping.

*Cost-effectiveness*

In order to compare the cost-effectiveness between:

1) Supported Self-management + verum splint vs. Supported Self-management,

2) Supported Self-management + placebo splint vs. Supported Self-management, and for completeness

3) Supported Self-management + verum splint vs. Supported Self-management + placebo splint,

we carried out an incremental analysis. Specifically, we calculated the incremental cost-effectiveness ratio (ICER) by dividing the mean cost difference between the relevant arms by the mean QALY difference. As per NICE recommendations,[4] we judged an intervention to be cost-effective if the ICER was £20,000 per QALY gained or below.

We used the non-parametric percentile method for calculating the confidence interval around the ICER using 1,000 bootstrap estimates of the mean cost and QALY differences[5]. Results of the 1000 bootstrap estimates are also presented in the cost-effectiveness plane. We used the cost-effectiveness acceptability curve to show the probability that the different interventions are cost-effective at 12 weeks for the £20,000 per QALY NICE threshold, and also for different values of the NHS’s willingness to pay for an additional QALY[6].

*Sensitivity analyses*

To assess the robustness of the primary analysis results with regards to some of their underlying assumptions, we performed a number of sensitivity analyses.

1. Multiple imputation using chained equations (MICE)[7] facilitated the analysis of the intention-to-treat population on all randomised participants. Missing data for utilities and health resource at 8 and 12 weeks post randomisation were imputed simultaneously using linear regression models. Imputations were based on a predicted mean matching approach, imputing observed values from the pool of the five data points with the most similar predictive values[57]. Additional variables included in the imputation model were gender, age at randomisation, baseline utility, the AUSCAN hand pain and function indices collected at baseline and follow-up, whether the treated hand is the dominant hand, and randomisation site. Imputations were performed separately by treatment arm. Using Stata’s ‘mi impute’ command, a total of 30 sets of imputed values were generated, and combined with the ‘mi estimate’ command to account for uncertainty around the imputations.
2. In a second sensitivity analysis, we investigated the effect on the trial conclusions of removing hospital admissions, A&E visits and use of ambulance services from the total costs. The rationale for this sensitivity analysis was that very few of these health resource uses were observed in the trial, and, due to their high cost relative to other costs incurred in the trial, they notably increased the variation in outcomes. As these events were deemed highly unlikely to be related to the trial interventions by the chief investigator, we decided to exclude them in the sensitivity analysis, to assess how this would affect trial results.
3. The primary analysis was repeated on the per-protocol population, to assess how non-adherence to key aspects of the protocol affected the conclusions drawn from this trial. Participants are excluded from the per-protocol population if:

• If they did not receive their allocated intervention at baseline (i.e. verum splint, placebo splint, or no splint);

• If they were not given all protocol stipulated materials to take home after their baseline appointment, as recorded on the ‘intervention delivery’ CRF (ARUK osteoarthritis information booklet, OTTER II joint protection booklet, OTTER II exercise booklet, Elastic bands/ pegs as required for exercises, personal exercise guide (original) for all participants, and splint, splint wear hours guide and personal splint wear guide (original) for participants allocated to either of the two splint arms);

• If they received intra-articular steroid injections to either hand prior to the relevant follow-up time point;

• If they received surgery to either hand prior to the relevant follow-up time point;

• If they were given a verum splint by a clinician prior to the relevant time point if allocated to self-management or placebo splint;

• If they reported that they purchased their own commercial thumb splint prior to the relevant time follow-up point if allocated to self-management or placebo splint and self-management;

• If they received any thumb OA splint that was not one of the trial options prior to the relevant follow-up time point;

• If they did not attend the 4 week appointment;

• If they experienced significant events such as non-trial related illness or injuries, that were considered could feasibly affect their hand function and/or trial outcomes;

Note: for the statistical analysis, different analysis populations are generated for the 8 and 12 week follow-up.

Participants’ follow-up data will be excluded from the per-protocol population for the cost-effectiveness sensitivity analysis if they meet any of the criteria above at any time point.

**Table SF8.1: Unit costs used in this cost-effectiveness analysis**

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| --- | --- | --- |
| **Cost item** | **Cost** | **Data source** |
| Verum Procool splint | £19.96 | NHS cost obtained from trial team. The discounted cost for the trial was £9.50. |
| Verum Orfilight splint | £11.50\* | \*Approximate costs of materials obtained from trial team.  The Verum Orfilight splint required additional preparation time, estimated to be 20 minutes by the trial team and clinical members of the oversight committee. These 20 minutes will be added to the intervention delivery time, and costed according to staff band as described below. |
| Placebo Thumb Sleeve | £11.05 | Costs for trial obtained from trial team. |
| Placebo Thumb Sleeve Lite | £15.13 | Costs for trial obtained from trial team. |
| GP visit | £31 | Personal Social Services Research Unit (PSSRU), online unit cost database of health and social care professionals 2017/2018: GP including direct care, cost per surgery lasting 9.22 minutes. |
| GP home visit | £78 | Home visits were not covered in the PSSRU Unit Costs of Health & Social Care 2018. In 2013 version of the document, out-of-surgery visits, including travel time and longer visit durations, cost approximately 2.5 times as much as GP patient consultations in surgery. The cost of a GP consultation in surgery is hence multiplied by 2.5. |
| GP phone conversation | £14 | The PSSRU Unit Costs of Health & Social Care 2018 identifies the duration of GP telephone triage as lasting 4 minutes on average. One hour of GP patient contact time, including direct care cost is estimated as £204 in PSSRU Unit Costs of Health & Social Care 2018. |
| Hospital outpatient visit with specialist/ consultant | £143 | National Schedule of Reference Costs 2017-2018, AE tab, weighted average of all consultant cases. |
| A&E visit | £160 | National Schedule of Reference Costs 2017-2018, AE tab, weighted average of all admitted and non-admitted cases, excluding those where categorised as “Emergency medicine, patient dead on arrival” |
| Ambulance service | £233 | National Schedule of Reference Costs 2017-2018, AMB tab, weighted average of all “see and treat and refer” and “see and treat and convey” |
| Day in hospital (excluding IC) | Variable | Costs obtained from National Schedule of Reference Costs 2017-2018 based on diagnosis and procedure codes. |
| **HEALTH CARE WORKERS** | | |
| Nurse in clinic | £9 | Personal Social Services Research Unit (PSSRU), online unit cost database of health and social care professionals 2017/2018: Cost per hour: £36. Estimate £9 per consultation based on an average consultation lasting 15.5 minutes (referenced in PSSRU 2015). |
| Nurse at home | £23 | Calculated in line with GP home visits as described above. |
| Physiotherapist | £57 | National Schedule of Reference Costs 2017-2018, CHS tab, weighted average of “Physiotherapist, Adult, One to One” and “Physiotherapist, Adult, Group” |
| Occupational therapist | £81 | National Schedule of Reference Costs 2017-2018, CHS tab, weighted average of “Occupational Therapist, Adult, One to One” and “Occupational Therapist, Adult, Group” |
| Psychologist | £44 | Personal Social Services Research Unit (PSSRU), online unit cost database of health and social care professionals 2017/2018: Cost per hour for scientific and professional staff. Grade 7. |
| Counsellor | £53 | Personal Social Services Research Unit (PSSRU), online unit cost database of health and social care professionals 2017/2018: Cost per hour for scientific and professional staff. Grade 6. |
| Day hospital | £727 | Weighted average of all day cases, excluding paediatric cases and cases related to ante-natal, neonatal or fertility related admissions. Obtained from the National Schedule of Reference Costs – Year 2015-16 file “The main schedule”, “DC” tab. |
|  |  |  |
| **Trial appointment** | Intervention delivery – physiotherapist/ OT |  |
|  | Costs per hour | Personal Social Services Research Unit (PSSRU), online unit cost database of health and social care professionals 2017/2018: Cost per hour for hospital based scientific and professional staff. |
| Band 5 | £35 |
| Band 6 | £46 |
| Band 7 | £55 |
| Band 8a | £66 |
| Band 8b | £78 |
| Band 8c | £91 |
| Band 8d | £110 |
| Band 9 | £134 |

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