A Systematic Review of Health State Utility Values in the Plastic Surgery Literature

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Background: Cost-utility analyses assess health gains acquired by interventions by incorporating weighted health state utility values (HSUVs). HSUVs are important in plastic and reconstructive surgery (PRS) because they include qualitative metrics when comparing operative techniques or interventions. We systematically reviewed the literature to identify the extent and quality of existing original utilities research within PRS.

Methods: A systematic review of articles with original PRS utility data was conducted in accordance with the Preferred Reporting Items for a Systematic Review and Meta-Analysis guidelines. Subspecialty, survey sample size, and respondent characteristics were extracted. For each HSUV, the utility measure [direct (standard gamble, time trade off, visual analog scale) and/or indirect], mean utility score, and measure of variance were recorded. Similar HSUVs were pooled into weighted averages based on sample size if they were derived from the same utility measure.

Results: In total, 348 HSUVs for 194 disease states were derived from 56 studies within seven PRS subspecialties. Utility studies were most common in breast (n = 17, 30.4%) and hand/upper extremity (n = 15, 26.8%), and direct measurements were most frequent [visual analog scale (55.4%), standard gamble (46.4%), time trade off (57.1%)]. Studies surveying the general public had more respondents (n = 165, IQR 103–299) than those that surveyed patients (n = 61, IQR 48–79) or healthcare professionals (n = 42, IQR 10–109). HSUVs for 18 health states were aggregated.

Conclusions: The HSUV literature within PRS is scant and heterogeneous. Researchers should become familiar with these outcomes, as integrating utility and cost data will help illustrate that the impact of certain interventions are cost-effective when we consider patient quality of life. (Plast Reconstr Surg Glob Open 2021;9:e3944; doi: 10.1097/GOX.0000000000003944; Published online 29 November 2021.)

INTRODUCTION

Economic evaluation research is a crucial element of cost-effective surgical decision-making and the minimization of unnecessary healthcare spending.1 Although several types of economic evaluation are commonly reported, a major advantage of using cost-utility analyses (CUA) is the assessment of health benefits in terms of patient health states rather than cost alone.12 CUAs incorporate quantitative and qualitative metrics when comparing operative techniques or interventions with nonoperative management. These analyses are particularly important in plastic and reconstructive surgery (PRS), as some of the most significant improvements after interventions are related to increasing patient quality, rather than quantity, of life.5,6

The methodology for completing a CUA is complex. To identify if the health gains acquired by interventions are justified by associated costs, clinical outcomes are measured using quality-adjusted life years. Quality-adjusted life years measure disease burden in terms of survival and health-related quality of life by assessing an individual’s preference for living in a given health state.5,6,7 These preference weights are otherwise known as health state utility values (HSUVs) and are typically scaled from 0 (death) to 1 (ideal health).
health). Metrics to derive HSUVs vary and include direct and indirect survey instruments that can be administered to patients, the general public, and/or healthcare providers. Direct measures include standard gamble (SG), time trade off (TTO), and visual analog scale (VAS), with variation within measures based on study design. Depending on the instrument, individuals are asked to gamble on a hypothetical intervention that may cause perfect health or death (SG), trade part of future life for a period of shorter, perfect health (TTO), or rate a health state on a visual scale from 1 to 100 (VAS). Indirect measures, in contrast, obtain preference weights by using prespecified health state classification systems [ie, the Health Utility Index, Short Form-6-Dimension (SF-6D), EuroQol 5-dimension questionnaire (EQ-5D), among others]. Quality-adjusted life years are then calculated by multiplying the life-years obtained from an intervention by its HSUV.

In a systematic review of HSUVs in the surgical literature in 2004, only three studies within PRS were included. The importance of HSUVs in PRS cost analyses has been emphasized since that time; however, widespread implementation has been slow. The purpose of this study was threefold: (1) To systematically review the PRS literature and evaluate the state of HSUV research, (2) to aggregate this data where appropriate into a useable database of HSUVs that can be referenced by investigators interested in performing CUAs, and (3) to critically appraise the quality of the included studies using a pre-established set of criteria.

METHODS

Inclusion and Exclusion Criteria

The systematic review was conducted in accordance with the Preferred Reporting Items for a Systematic Review and Meta-Analysis checklist. (See figure, Supplemental Digital Content 1, which shows the Preferred Reporting Items for a Systematic Review and Meta-Analysis 2020 checklist. Articles were considered eligible for inclusion if they were full-text and reported original HSUVs for health states associated with PRS procedures. PRS was defined according to the American College of Surgeons as procedures involving the “repair, reconstruction, or replacement of physical defects of form or function involving the skin, musculoskeletal system, cranio and maxillofacial structures, hand, extremities, breast and trunk, and external genitalia.” Abstracts alone, editorials, commentaries, and systematic reviews were excluded, as were economic analyses that did not utilize HSUVs or did not report derived HSUVs.

Search Strategy

A literature search was conducted on 1/19/2021 within the MEDLINE, Embase, Cochrane, Web of Science, Scopus, and CINAHL electronic databases. Search strategies were individualized to the databases as appropriate. Key search terms were derived and adapted from previously published recommendations as Medical Subject Headings (MeSH) terms do not cover all HSUVs. (See figure, Supplemental Digital Content 2, which shows the systematic review search strategies checklist.)

Data Extraction

Characteristics of the included studies were extracted with predefined variables, which included year of publication, publication journal, study country, subspecialty, respondent sample size, and whether or not a CUA was performed. For each HSUV, the utility measures [SG, TTO, VAS, EQ-5D, Health Utility Index, SF-6D, 15D (15 Dimension), QWB (Quality of Well Being Index), AQLQ (Assessment of Quality of Life)], point estimate (mean), and measure of variance (SD, confidence interval, interquartile range) were recorded. If multiple HSUVs were derived for the same health state, they were all collected.

Quality Reporting

The quality of each study was evaluated through criteria proposed by Papaioannou et al. Each study was evaluated for (1) sample size of 100 or more; (2) description of respondent selection/recruitment; (3) description of inclusion/exclusion criteria; (4) response rate of 60% or more; (5) reporting of the amount and reasons of loss to follow-up; (6) reporting of missing data and methods to deal with missing data; and (7) appropriateness of measure. The individual scores were summed for an overall score (0–7), with higher scores indicating higher quality.

Statistical Analysis

Standard descriptive statistics were used to report counts and frequencies of categorical data. Utility scores were pooled into a weighted average and variance based on sample size if scores existed for the same health state and were derived from the same utility metric. For ease of interpretation, the range of HSUVs derived for each health state was represented graphically.

Takeaways

**Question:** A systematic review of the literature to identify the extent and quality of existing original health state utility value (HSUV) research within PRS.

**Findings:** The PRS HSUV literature is scant and heterogeneous. Fifty-six studies within seven PRS subspecialties derived 348 HSUVs for 194 disease states. Only 18 health states were able to be aggregated.

**Meaning:** Integrating utility and cost data will help illustrate that the impact of certain interventions is cost effective when we consider quality of life.
RESULTS

Study Selection

The search strategy identified 1298 articles (Fig. 1). After removing duplicates, 1214 articles were scanned by title/abstract, and 1110 articles were excluded for either having the wrong patient population (not PRS), or the wrong outcomes (no original HSUVs). Seventy-one articles were retrieved and reviewed in full. An additional 15 records were excluded during the full-text review, leaving 56 studies.

The study characteristics are summarized in Table 1. Content included musculoskeletal (MSK)/abdominal wall reconstruction (n = 1, 1.79%), breast (n = 17, 30.4%), skin/body contouring (n = 4, 7.14%), facial plastics (n = 13, 23.2%), hand/upper extremity (n = 15, 26.8%), pediatrics/craniofacial (n = 4, 7.14%), and lower extremity (n = 2, 3.57%). Direct measurements were most frequent (TTO: n = 32, 57.1%; VAS: n = 31, 55.4%; SG: n = 26, 46.4%). Indirect methods were less common (n = 12, 21.4%); however, of these, the EQ-5D was used most frequently (n = 6, 50%). Twenty-eight of the studies used one measurement to derive HSUVs, and 28 utilized more than one measurement, thus providing multiple HSUVs for a single health state.

Respondent populations included patients, general public, or healthcare professionals (see Table 1). Forty-one studies surveyed one of these populations (73.2%), while 15 reported HSUVs from a combination of these groups (26.8%). When a combination of groups was utilized, studies reported overall HSUVs as well as HSUVs for each population. Studies surveying the general public had the most respondents (n = 165, IQR 103–299), followed by patients (n = 61, IQR 48–79) and healthcare professionals (n = 42, IQR 10–109). The sample sizes varied widely from nine to 355 with a median of 101 respondents per study. Twenty studies included a CUA in addition to deriving original HSUVs.

Quality Assessment

In all of the studies included, the utility metric was considered appropriate by the authors (100%), and 58.9% had a sample size greater than 100. Nearly all described how respondents were recruited (98.2%) and the inclusion/exclusion criteria (94.6%). True response rates were difficult to ascertain in studies that surveyed the general public, as many sent electronic surveys or publicly advertised and therefore included whomever responded. An estimated 13 studies clearly stated response rates greater than 60%. Where appropriate, most longitudinal studies reported reasons or loss to follow up (n = 11 studies); however, few studies reported the extent of missing data and how it was handled (3.57%). The summed scores are found in Table 1, and the individual scores in Supplemental Digital Content 3.

HSUVs

A total of 348 original HSUVs for 194 health states were retrieved from the 56 studies included in this analysis.

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**Fig. 1.** Preferred Reporting Items for a Systematic Review and Meta-Analysis flow diagram.
Table 1. Studies Deriving Original HSUVs in the PRS Literature (n = 56)

| PRS Specialty | Author | Year | Country | Journal | Health State | Instrument | Sample Size | Respondents |
|---------------|--------|------|---------|---------|--------------|------------|-------------|-------------|
| Abdominal wall | Fischer et al | 2016 | USA | Plastic and Reconstructive Surgery | Incisional hernia | VAS | 300 | x |
| Body contouring | Ibrahim et al | 2014 | USA | Annals of Plastic Surgery | Excess arm skin | VAS, TTO, SG | 118 | x |
| | Sinno et al | 2011 | USA | Aesthetic Plastic Surgery | Excess skin after massive weight loss | VAS, TTO, SG | 100 | x |
| | Izadpanah et al | 2013 | USA | Annals of Plastic Surgery | Thigh lift | VAS, TTO, SG | 112 | x |
| | Sinno et al | 2012 | USA | Otolaryngology Head and Neck Surgery | Excess neck skin | VAS, TTO, SG | 104 | x |
| Breast | Ibrahim et al | 2015 | USA | Plastic Surgery | Breast ptosis | VAS, TTO, SG | 118 | x |
| | Araújo et al | 2014 | Brazil | Aesthetic Surgery Journal | Breast hypertrophy | SF-6D | 58 | x |
| | Saariniemi et al | 2012 | Finland | Journal of Plastic Reconstructive and Aesthetic Surgery | Breast hypertrophy | SF-6D | 62 | x |
| | Saariniemi et al | 2008 | Finland | Journal of Plastic Reconstructive and Aesthetic Surgery | Breast hypertrophy | SF-6D, 15D | 29–35 | x |
| | Thoma et al | 2007 | Canada | Plastic and Reconstructive Surgery | Breast hypertrophy | EQ-5D, Health Utility Index | 49 | x |
| | Tykkä et al | 2008 | Finland | Journal of Plastic Reconstructive and Aesthetic Surgery | Breast hypertrophy | 15-D | 80 | x |
| | Kerrigan et al | 2000 | USA | Plastic and Reconstructive Surgery | Breast hypertrophy | VAS, SG, EQ-5D | 47 | x |
| | Chang et al | 2001 | USA | Plastic and Reconstructive Surgery | Breast hypertrophy | VAS, TTO, SG | 355 | x |
| | Sinno et al | 2014 | USA | Journal of Reconstructive Microsurgery | Unilateral mastectomy defect | VAS, TTO, SG | 140 | x |
| | Sinno et al | 2013 | USA | Breast | Bilateral mastectomy | VAS, TTO, SG | 120 | x |
| | Chatterjee et al | 2013 | USA | Plastic and Reconstructive Surgery | Autologous reconstruction | VAS or TTO | 10 | x |
| | Chatterjee et al | 2015 | USA | Plastic and Reconstructive Surgery | Autologous reconstruction | VAS | 21 | x |
| | Thoma et al | 2003 | Canada | Microsurgery | Autologous reconstruction | VAS | 33 | x |
| | Thoma et al | 2004 | Canada | Plastic and Reconstructive Surgery | Autologous reconstruction | VAS | 32 | x |
| | Grover et al | 2013 | USA | Plastic and Reconstructive Surgery | Autologous and implant reconstruction | VAS | 9 | x |
| | Krishnan et al | 2013 | USA | Plastic and Reconstructive Surgery | Implant reconstruction | VAS | 10 | x |
| | Krishnan et al | 2014 | USA | Journal of Plastic Reconstructive and Aesthetic Surgery | Implant reconstruction | VAS | 10 | x |

(Continued)
| PRS Specialty | Author(s) | Year | Country | Journal | Health State | Instrument | Sample Size | General Public | Healthcare Professionals | Patients | CUA QA* |
|---------------|-----------|------|---------|---------|-------------|------------|-------------|----------------|------------------------|----------|--------|
| Facial plastics | Dey et al | 2016 | USA | JAMA Facial Plastic Surgery | Facial defect reconstruction | VAS, SG | 290 | x | x | No | 6 |
| | Sinno et al | 2010 | Canada | Plastic and Reconstructive Surgery | Facial disfigurement | VAS, TTO, SG | 256 | x | x | No | 4 |
| | Chuback et al | 2015 | Canada | Burns | Facial disfigurement | TTO, SG | 75 | x | x | No | 4 |
| | Gadkaree et al | 2019 | USA | JAMA Facial Plastic Surgery | Nasal obstruction/septorhinoplasty | EQ-5D | 160–463 | x | No | 4 |
| | Oladokun et al | 2018 | Germany | Aesthetic Plastic Surgery | Nasal deformity/septorhinoplasty | SF-6D | 67 | x | Yes | 4 |
| | Gadkaree et al | 2019 | USA | JAMA Facial Plastic Surgery | Nasal obstruction/septoplasty | EQ-5D | 185–278 | x | No | 4 |
| | Kumar et al | 2020 | USA | JAMA Facial Plastic Surgery | Nasal obstruction/septoplasty | VAS, SG | 167 | x | No | 4 |
| | Sinno et al | 2012 | USA | Annals of Plastic Surgery | Repeat rhinoplasty | VAS, TTO, SG | 128 | x | x | No | 2 |
| | Faris et al | 2019 | USA | Laryngoscope | Nasal defect/thinectomy | VAS, TTO, SG | 273 | x | No | 2 |
| | Su et al | 2017 | USA | JAMA Facial Plastic Surgery | Facial paralysis | VAS, TTO, SG | 348 | x | No | 4 |
| | Faris et al | 2018 | USA | JAMA Facial Plastic Surgery | Facial paralysis | VAS, TTO, SG | 298 | x | No | 4 |
| | Sinno et al | 2012 | Canada | Annals of Plastic Surgery | Facial paralysis | VAS, TTO, SG | 101 | x | x | No | 5 |
| | Abt et al | 2018 | USA | JAMA Facial Plastic Surgery | Alopecia | VAS, TTO, SG | 308 | x | No | 4 |
| Hand/upper extremity | Cavaliere et al | 2008 | USA | The Journal of Hand Surgery | Tetrplegia | TTO | 118 | x | No | 4 |
| | Cavaliere et al | 2010 | USA | The Journal of Hand Surgery | Rheumatoid arthritis | TTO | 73 | x | No | 4 |
| | Cavaliere et al | 2010 | USA | Hand | Rheumatoid arthritis | TTO | 109 | x | x | Yes | 4 |
| | Fernandes-de-Las-Penas et al | 2019 | Spain | The Journal of Orthopaedic and Sports Physical Therapy | Carpal tunnel syndrome | EQ-5D | 60 | x | Yes | 3 |
| | Korhala-de-Bos et al | 2006 | Netherlands | Archives of Physical Medicine and Rehabilitation | Carpal tunnel syndrome | EQ-5D | 70–83 | x | Yes | 4 |
| | Atrosli et al | 2007 | Sweden | The Journal of Hand Surgery | Carpal tunnel syndrome | SF-6D | 100 | 12–30 | x | No | 4 |
| | Alokhil et al | 2015 | Canada | The Journal of Hand Surgery | Hand amputation/ transplantation | TTO, SG | 100 | x | No | 4 |
| | Chung et al | 2010 | USA | Plastic and Reconstructive Surgery | Thumb amputation/free toe flap | TTO, SG | 30 | x | No | 4 |
| | Efanov et al | 2018 | Canada | Journal of Reconstructive Microsurgery | Ulnar neuropathy | TTO | 102 | x | Yes | 6 |
| | Song et al | 2012 | USA | The Journal of Hand Surgery | Distal radius fracture | TTO | 51 | x | No | 4 |
| | Koenig et al | 2009 | USA | The Journal of Bone and Joint Surgery | Scaphoid fracture | TTO | 50 | x | Yes | 4 |
| | Davis et al | 2006 | USA | Plastic and Reconstructive Surgery | Dupuytren’s contracture | SG | 50 | x | Yes | 3 |
| | Chen et al | 2011 | USA | The Journal of Hand Surgery | Unilateral lower extremity lymphedema | VAS, TTO, SG | 144 | x | No | 5 |
| | Sinno et al | 2014 | USA | Annals of Plastic Surgery | Open tibial fracture | SG | 65 | x | x | No | 5 |
| Pediatrics/craniofacial | Chung et al | 2011 | USA | Annals of Plastic Surgery | Clef lip and palate | VAS, TTO, SG | 110 | x | No | 6 |
| | Wehby et al | 2006 | USA | The Cleft-palate Craniofacial Journal | Cleft lip and palate | VAS, TTO, SG | 110 | x | No | 6 |
| | Sinno et al | 2012 | USA | Plastic and Reconstructive Surgery | Mandibular and maxillary hypoplasia | VAS, TTO | 162 | x | Yes | 4 |
| | Almadani et al | 2020 | Canada | Journal of Craniofacial Surgery | Scaphocephaly | VAS, TTO, SG | 118 | x | x | No | 4 |
| | Kuta et al | 2017 | Canada | Journal of Neurosurgery: Pediatrics | | | | | | |

*Summed Quality Assessment Scores (from Papaionannou et al. 2013).
Individual HSUVs were organized by subspecialty. HSUVs along with the corresponding utility metric, respondent sample size, mean respondent age, and variance, can be found in Supplemental Digital Content 4. (See figure, Supplemental Digital Content 4, which shows a database of original and aggregated health state utility values by plastic and reconstructive surgery subspecialty. http://links.lww.com/PRSOGO/B852.)

Twenty-three studies (41.1%) reported preintervention and postintervention HSUVs, 20,22,24,27,29,31,44,45,46,48,54,57,58,61,63,65,67–69,73 and 15 (26.8%) 20,26,27,30,32,34,36,37,57,62,63,66,68,69,74 reported HSUVs associated with procedure-related complications. Three studies (5.3%) looked at HSVUs after aesthetic procedures, including nasal deformity and cosmetic rhinoplasty, 46 hair loss and hair transplant, 53 and thigh lifts. 39 HSUVs were most commonly derived in the breast literature, with the most common disease state being breast hypertrophy with or without reduction mammoplasty (n = 7 studies). 21–24,29,31,35 In the studies that derived HSUVs for breast reconstruction, the respondent populations were healthcare professionals only (plastic surgeons, n = 9–33), and all included a CUA. 26,27,30,32,34,36,37 Utilities for hand disease states and related hand surgery procedures were the next most common, and CUAs were performed in seven of 15 studies. 56,57,64,65,66,68,69 MSK/abdominal wall reconstruction, skin/body contouring, pediatrics/craniofacial, and lower extremity had the least number of studies deriving HSUVs, and only two studies from these four specialties included CUAs. 26,73 The ranges of HSUVs for preintervention and postintervention disease states are represented in Figure 2.

Only 18 disease states had multiple HSUVs derived from the same utility metric that were eligible for aggregation. Tetraplegia had the lowest aggregated HSUV (0.47 ± 0.3), whereas patients 1-year after functional septoplasty/septohinoplasty had the highest aggregated HSUV (0.92 ± 0.14). (See Supplemental Digital Content 4, http://links.lww.com/PRSOGO/B852.)

**DISCUSSION**

This is the first systematic review to examine the prevalence and quality of original HSUV literature in PRS. Our results demonstrate that there has been a small and steady increase in the number of publications per year dedicated to utility score outcomes (Fig. 3). Unfortunately, recent literature has found that CUAs, despite their robust and comprehensive methodology, remain the least frequently reported type of economic evaluation. 75 This houses an immense opportunity for the PRS community. As many of the conditions we treat are measured by subjective effectiveness of an intervention.81,82 Larger repositories of utility values are needed for comparative and value analyses. For those interested in conducted HSUV and CUA research, utilizing and aggregating multiple methods to derive HSUVs should be considered, as this may provide a more accurate HSUV for inclusion in a CUA.

Utility Measures

It has been previously demonstrated that utilizing different measures to derive HSUVs may yield conflicting results. 60,61 Specifically, the use of VAS over SG or TTO and indirect over direct methods, have resulted in lower utility values for a range of disease states. 78,80 These findings were corroborated here. In three separate studies that derived HSUVs using VAS, TTO, and SG for patients with moderate facial paralysis, aggregated VAS scores were on average lower (0.65 ± 0.2) than TTO (0.81 ± 0.22) or SG (0.82 ± 0.2). The same was true for patients with severe facial paralysis [VAS (0.52 ± 0.21), TTO (0.72 ± 0.27), SG (0.76 ± 0.24)]. These discrepancies were also noted in postoperative health states. Faris et al compared direct measurements for 298 patients undergoing facial re-animation, and reported VAS scores of 0.74 ± 0.19, but TTO and SG scores of 0.84 ± 0.19 and 0.84 ± 0.21, respectively. 52 Similarly, Izadpanah et al found that HSUVs for patients after thigh lift procedures were 0.77 ± 0.15 if patients completed VAS, but 0.9 ± 0.11 and 0.89 ± 0.14 if they completed TTO or SG. 99 This is important as the potential incremental gains for an intervention are dependent on baseline values, and a difference of even 0.1 may alter the results of a CUA to favor one intervention or another. The variability and discrepancies between methods may therefore preclude the use of a single method to analyze cost-effectiveness of an intervention. 31,92 Larger repositories of utility values are needed for comparative and value analyses. For those interested in conducted HSUV research, utilizing and aggregating multiple methods to derive HSUVs should be considered, as this may provide a more accurate HSUV for inclusion in a CUA.

Respondents

According to the first Panel on Cost-Effectiveness in Health and Medicine, the use of “societal perspective” best facilitated the goals of making comparisons across
interventions and patient groups, and recommended the use of the general public as respondents when possible. In the second panel, the authors recommend both societal and healthcare sector perspectives be reported. The healthcare sector is utilized based on the rationale that individuals can personally or professionally relate to the disease state in question. However, research has noted that patients who have adapted to their chronic health state may experience a better health-related quality of life than perceived by others leading to higher HSUVs. No clear trends in reported HSUVs by respondent populations were elicited in this review. Importantly, none of the studies that included CUAs in this review utilized societal and healthcare perspectives. Admittedly, choice of respondent population may be dictated by resource availability, as utilizing physicians and medical students may be the most time-efficient and cost-effective, however readers who seek to conduct HSUV and CUA research should aspire.

Fig. 2. Range of baseline and postintervention HSUVs.
to adhere to the panel’s recommendation for including these populations, as it may improve the quality of future research. Further, studies that survey multiple respondent populations should report separate HSUVs for each population to increase transparency of the results.

Cost Analyses
In two systematic reviews of economic evaluations in PRS conducted in 2014 and 2021, six and 10 CUAs were reported in the literature.\textsuperscript{16} Our review identified 20 CUAs; however, readers should be aware that the true incidence of CUAs in the PRS literature may be underestimated in this and other works as the lack of medical subject heading (MeSH) terms makes it difficult to systematically review this literature. Two additional important studies warrant mentioning. In 2013 and 2014, Thoma et al published the first randomized control trial in parallel to a CUA, and found variations in economic value of two mammoplasty techniques depending on the perspective used (societal/patient versus ministry of health).\textsuperscript{86,87} These results were particularly important in elucidating why utility measurement is so important in PRS while additionally highlighting that using a clinical trial alongside an economic evaluation is more transparent and intuitive to clinicians. Researchers are encouraged to report their derived HSUVs and include cost analyses, as describing and integrating these will help streamline future utilities research and demonstrate if interventions are cost-effective.

Limitations
A limitation of this study, and of all studies that attempt to systematically review utility research, is the lack of MeSH terms for common HSUVs. We utilized Papaionannou et al’s guide for systematically reviewing the HSUV literature\textsuperscript{17} and cross-referenced to collect an unbiased and inclusive selection of studies, but acknowledge that literature may have been missed in our search. Established MeSH terms would facilitate and improve the accuracy of similar reviews in the future. Further, details on the extent of missing data and how this missing data was accounted for when deriving utility measures were not commonly reported amongst these studies. This must be considered in interpreting the included results, and the statistical validity of future work would be substantiated by the inclusion of this information. Two additional quality metrics, loss to follow up and response rate, were difficult to assess in many of the included studies, making our summed quality analysis challenging to interpret. Losing respondents to follow-up was not relevant to studies that were cross-sectional in nature, and true response rate was not able to be calculated in studies that recruited members voluntarily based on advertisements. The heterogeneity of study type therefore negatively influenced our ability to make conclusions regarding the quality of the study group as a whole. Studies utilizing patient populations in a longitudinal manner should continue to report response rate and follow up metrics as this information increases the transparency of the work.

CONCLUSIONS
This systematic review has identified gaps in the current HSUV literature as well as the need for standardization of methodologic tools and characteristics of respondent populations to limit variation and increase the generalizability and validity of utility scores. The importance of continuing to conduct and refine HSUV research in the
PRS community cannot be understated, as HSUVs are objective means to demonstrate that PRS procedures are impactful. Integrating these values with cost data will help illustrate that the certain interventions are cost-effective when we consider health-related quality of life.

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