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Assessing value in breast reconstruction: A systematic review of cost-effectiveness studies

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Summary *Introduction:* Breast reconstruction is one of the most common procedures performed by plastic surgeons and is achieved through various choices in both technology and method. Cost-effectiveness analyses are increasingly important in assessing differences in value between treatment options, which is relevant in a world of confined resources. A thorough evaluation of the cost-effectiveness literature can assist surgeons and health systems evaluate high-value care models.
Methods: A systematic review of PubMed, Web of Science, and the Cost-Effectiveness Analysis Registry was conducted. Two reviewers independently evaluated all publications up until August 17, 2017.
Results: After removal of duplicates, 1996 records were screened, from which 53 studies underwent full text review. All the 13 studies included for final analysis mention an incremental cost-effectiveness ratio. Five studies evaluated the cost-effectiveness of technologies including acellular dermal matrix (ADM) in staged prosthetic reconstruction, ADM in direct-to-implant (DTI) reconstruction, preoperative computed tomography angiography in autologous reconstruction, indocyanine green dye angiography in evaluating anastomotic patency, and abdominal mesh reinforcement in abdominal tissue transfer. The remaining eight studies evaluated the cost-effectiveness of different reconstruction methods. Cost-effective strategies included free vs. pedicled abdominal tissue transfer, DTI vs. staged prosthetic reconstruction, and fascia-sparing variants of free abdominal tissue transfer.
Conclusions: Current evidence demonstrates multiple cost-effective technologies and methods in accomplishing successful breast reconstruction. Plastic surgeons should be well informed of

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such economic models when engaging payers and policymakers in discussions regarding high-value breast reconstruction.

Introduction

Breast reconstruction is one of the most common procedures performed by plastic surgeons. In the United States (US), over 106,000 procedures were performed in 2015,[1] and recent studies suggest that the volume is increasing as eligibility, desirability, and feasibility increase.[2,3] Currently, various treatment modalities (e.g., prosthetic,[4] autologous,[5] and hybrid reconstructions[6]) and technologies exist for breast reconstruction.[7] This variability provides opportunity to investigate whether a technology or method is superior to another in cost, quality, or both. This is particularly relevant in the contemporary climate of restrictive financial resources and an ever-increasing push toward value-based reimbursement of services, whereby value equals health outcomes divided by costs.[8]

In the United Kingdom, the National Institute for Health and Care Excellence oversees determinations of value regarding drugs, technologies, and procedures,[9] and often incorporates cost-effectiveness analyses in decision-making. In the US, growing momentum for episodic reimbursement, both in the private insurance market and from Centers for Medicare/Medicaid Services (CMS), forces health systems to scrutinize total costs of surgical care and hone quality. Market pressures are also minimizing hospital margins, thus incentivizing cost containment, while health systems have begun enacting value-purchasing committees prior to purchasing new technology.[10] The combination of high procedural numbers and constant introduction of innovative techniques and technologies makes breast reconstruction particularly suitable for evaluating differences in value.

Cost-effectiveness analyses model the differences in effectiveness and costs between two or more interventions and were originally constructed to judge whether new interventions were worth incremental cost increases.[11] Since inception, cost-effectiveness analyses compare a variety of interventions, particularly when investigators are unaware of costs or effectiveness a priori. Although initially lagging in the surgical literature,[12] cost-effectiveness analyses are increasingly common. Effectiveness can be modeled in many ways including patient-reported outcomes, mortality, or readmission rates. The inherent problem of specific effectiveness outcomes is limited comparison to other analyses. Therefore, *utilities* were created as a common metric.[13] Utility is an index ranging from 0 to 1 that assesses an entire health state, taking into consideration all factors affecting a patient's quality of life. Thus, a study investigating the effectiveness of carpal tunnel release could be compared to cleft-lip repair. When utility is the effectiveness metric, the study can be called a cost-utility analysis. The effectiveness outcome is modeled against time along with the probability of permutations in care (e.g., complications). Some interventions have life-long effects, while others will be limited to the episode of care. The effectiveness metric,

$$\text{Incremental Cost Effectiveness Ratio} = \frac{(\text{Cost}_1 - \text{Cost}_2)}{(\text{Effectiveness}_1 - \text{Effectiveness}_2)} = \frac{\Delta\ \text{Cost}}{\Delta\ \text{Effectiveness}}$$

Figure 1 Formulaic display of the incremental cost-effectiveness ratio (ICER).

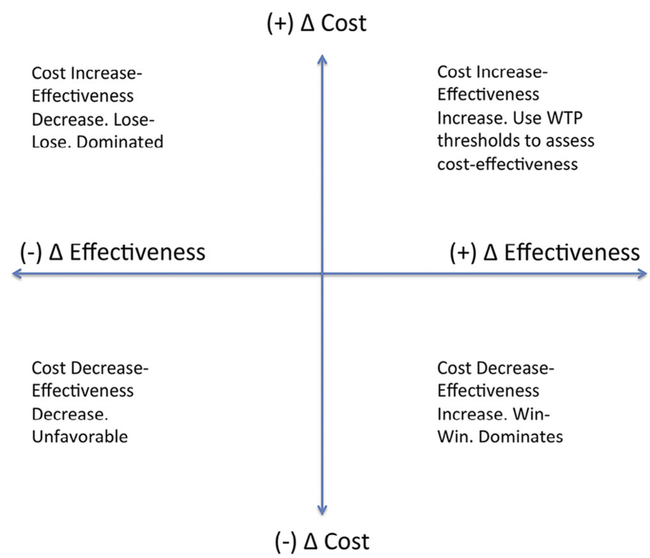

Figure 2 Graphical display of incremental cost versus incremental effectiveness. WTP, willingness to pay.

often utility, is multiplied by time to generate a quality-adjusted life year (QALY).[14] When alternative effectiveness outcomes are used, some borrow the term "QALY" to refer to the life year adjustments in their effectiveness outcome. For example, in breast reconstruction, some use the BREAST-Q[15] as an effectiveness outcome and call the time-adjusted metric a "Breast-QALY." Costs are modeled to follow the probabilities and complications for any given health state.

The ratio of cost to effectiveness is called the incremental cost-effectiveness ratio (ICER) (Figure 1). However, when using utility as the effectiveness metric, one can more precisely call the ratio an incremental cost-utility ratio (ICUR).[16] ICERs can be any negative or positive integer and can be represented graphically on a cost-effectiveness plan (Figure 2).[17] Often, ICERs are in the quadrant whereby there is gain in effectiveness at significant cost. The amount of increased cost to gain in effectiveness (e.g., QALY) is debatable. Conservative willingness to pay (WTP) thresholds start at $50,000, while some suggest higher thresholds at $100,000–$200,000.[18] Others argue that dwindling reimbursements and market pressures will place health systems in a state of only adopting cost-neutral or cost-saving technology.[10] Thus, with societal perspectives, WTP thresholds may remain in the $50,000–$200,000 range, but for the healthcare sector providing care, WTP may be much lower.