Cost-Effectiveness of Internet-Based Cognitive-Behavioral Treatment for Bulimia Nervosa:

Results of a Randomized Controlled Trial

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ABSTRACT

Objective: To evaluate the cost-effectiveness of Internet-based cognitive-behavioral therapy for bulimia nervosa (CBT-BN) compared to face-to-face delivery of CBT-BN.

Methods: This study is a planned secondary analysis of data from a randomized clinical trial. Participants were 179 adults (98% female, mean age = 28 years) meeting *DSM-IV* criteria for bulimia nervosa who were randomized to group face-to-face or group Internet-based CBT-BN for 16 sessions during 20 weeks. The cost-effectiveness analysis was conducted from a third-party payor perspective, and a partial societal perspective analysis was conducted to investigate cost-utility (ie, cost per gain in quality-adjusted life-years) and patient out-of-pocket travel-related costs. Net health care costs were calculated from protocol and nonprotocol health care services using third-party payor cost estimates. The primary outcome measure in the clinical trial was abstinence from binge eating and purging, and the trial start and end dates were 2008 and 2016.

Results: The mean cost per abstinent patient at posttreatment was $7,757 (95% confidence limit [CL], $4,515, $13,361) for face-to-face and $11,870 (95% CL, $6,486, $22,188) for Internet-based CBT-BN, and at 1-year follow-up was $16,777 (95% CL, $10,298, $27,042) for face-to-face and $14,561 (95% CL, $10,165, $21,028) for Internet-based CBT-BN. There were no statistically significant differences between treatment arms in cost-effectiveness or cost-utility at posttreatment or 1-year follow-up. Out-of-pocket patient costs were significantly higher for face-to-face (mean [95% CL] = $178 [$127, $140]) than Internet-based ($50 [$50, $50]) therapy.

Conclusions: Third-party payor cost-effectiveness of Internet-based CBT-BN is comparable with that of an accepted standard. Internet-based dissemination of CBT-BN may be a viable alternative for patients geographically distant from specialist eating disorder services who have an unmet need for treatment.

Trial Registration: ClinicalTrials.gov identifier: NCT00877786

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There is an urgent clinical need to make effective management of bulimia nervosa (BN) more widely available. Epidemiologic data suggest that 1.5% of women will develop bulimia nervosa in their lifetime.[1] The standardized mortality rate for patients with BN is twice as high as the annual death rate from all causes.[2] BN is a markedly distressing, time-consuming illness with substantial social, occupational, and financial impairments.[3] The impacts place the illness as a significant cause of burden of disease, particularly among young adult women.[4]

Studies on long-term course suggest that BN may persist throughout adulthood without treatment. In a community study of Finnish female twins,[5] 45% of individuals still had the illness 5 years after onset, and fewer than a third of cases had been detected by health professionals. Other estimates suggest that fewer than 1 in 5 women with an eating disorder receive professional help.[6] Evidence-based treatments have been developed, and the best-supported treatment is cognitive-behavioral therapy (CBT) specifically tailored for bulimia nervosa (CBT-BN).[7] The efficacy of CBT-BN has been demonstrated in many modes of delivery, including individual therapy, group therapy, Internet-based treatment, and other formats.[7] However, the accessibility of CBT-BN is a major issue because it is generally provided only by highly trained specialized eating disorder practitioners in urban-based settings; furthermore, this treatment is not widely distributed, even in urban settings. Informing efforts to disseminate treatment is therefore a public health priority.

In addition to accessibility, cost of eating disorder treatment is a concern, in part as eating disorders are perceived to be difficult and expensive to treat. The setting

Clinical Points

- Cost-effectiveness data help to inform treatment funders' decisions about which treatments should be implemented.
- The cost-effectiveness of Internet-based cognitive-behavioral therapy for bulimia nervosa was comparable to that of face-to-face treatment.
- Internet-based therapy has the potential to broaden access to treatment for bulimia nervosa.

of limited health care resources also makes cost of treatment an issue of interest to third party payors. Increasingly, studies that examine the clinical effectiveness of eating disorder treatment also attend to the cost-effectiveness of the evaluated interventions.[8] One way to improve the cost-effectiveness of treatments is to make them more effective, but changes to treatment delivery that lower costs also have potential to improve cost-effectiveness.

E-health interventions for eating disorders, including Internet-based treatment, have recently proliferated.[9] In studies of Internet-based CBT, efficacy has been demonstrated, and rates of binge-purge abstinence have ranged from 14% to 37% at posttreatment and from 30% to 39% at follow-up.[10–12] E-health facilitates access among individuals with geographic and other practical constraints and individuals reluctant to attend face-to-face psychotherapy due to stigma, shame, or social anxiety.[13] Improving access to effective care is likely to improve health outcomes and mitigate long-term morbidity. However, no studies have examined whether Internet-based CBT-BN is a cost-effective alternative to standard face-to-face CBT-BN. Hence, this study aimed to investigate this question. The hypotheses were that Internet-based CBT-BN would be at least as cost-effective as face-to-face CBT-BN, with effectiveness measured in terms of abstinence from binge eating and purging and improvement in quality of life.

METHOD

Participants

Participants in the current study comprised 179 adults randomized to face-to-face CBT-BN (n = 90) and Internet-based CBT-BN (n = 89). The trial was registered on ClinicalTrials.gov (identifier: NCT00877786) and has been published.[12] The hypothesis in the non-inferiority trial was that the proportion achieving abstinence with Internet-based CBT-BN would be noninferior to that with face-to-face CBT-BN.

Briefly, the randomized controlled trial took place at 2 sites, the University of North Carolina at Chapel Hill (UNC) and Western Psychiatric Institute and Clinic of the University of Pittsburgh Medical Center (UPMC). Participants met inclusion criteria for *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (*DSM-IV*)[14] bulimia nervosa and were aged ≥ 18 years and English-speaking and had reliable and private Internet access. Individuals were ineligible if they had a medical problem or developmental disability that would interfere with treatment, alcohol/drug dependence, severe suicidal ideation, schizophrenia, psychosis, or bipolar disorder or were pregnant. The study was conducted using an intent-to-treat approach. From the 196 who were randomized, only individuals who withdrew consent (n = 13), were terminated from the study (n = 3; ie, had a change in status during the study and met exclusion criteria), and had a missing baseline assessment (n = 1) were excluded. The study was approved by the institutional review boards at UNC and UPMC.

Procedures

Details of the design have been published previously.[12,15] Briefly, participants were randomized to group face-to-face or group Internet-based CBT-BN. A group modality was chosen to make intervention feasible in the study contexts. Group and individual CBT are similarly effective, although some research has found that individual CBT is associated with higher abstinence.[7] Each treatment arm included sixteen 1.5-hour sessions delivered over the course of 20 weeks. Patients in face-to-face CBT-BN had in-person group sessions at the treatment site. Patients in Internet-based CBT-BN convened with the therapist via an online chat group accessed with an anonymous username and password; the chat room included text-based messages only.

Measures

Outcome. The primary effectiveness outcome was abstinence from binge eating/purging during the past 28 days measured with the Eating Disorder Examination (EDE)[16] at posttreatment and 1-year follow-up. The abstinence proportions used were those reported in the outcome article[12]: at posttreatment, individuals with missing data were conservatively assumed to be non-abstinent in the study, and at 1-year follow-up, in light of attrition, abstinence was estimated with multiple imputation. Cost-effectiveness was calculated as the cost of treatment per abstinent patient.

The secondary effectiveness outcome was quality-adjusted life-years (QALYs), measured via the Short-Form Health State Classification (SF-6D),[17] which is derived from the SF-36, administered at baseline, posttreatment, and 1-year follow-up. The SF-6D is a utility-based measure of health-related quality of life[17] and has good validity.[18] The algorithm gives a value ranging between 0 (death) and 1 (perfect health). Cost-utility was calculated as the cost per QALY gained. QALY gain refers to the increase in QALYs before and after treatment; 1 QALY gain means that the person has gained 1 year in perfect health.

Intervention. Psychotherapy visits were derived from electronic attendance records. The patient was required to present at either the face-to-face or the Internet-based session (ie, securely log in) for a visit to be counted.

Nonprotocol health care. Patient encounters with health services that were not part of the CBT-BN trial intervention are considered to be nonprotocol costs and include, for instance, visits to primary care professionals and prescription

medications. Nonprotocol health care was calculated for posttreatment and 1 year follow-up using the McKnight Follow-up of Eating Disorders (M-FED).[19] The M-FED was administered to participants at posttreatment and 3, 6, and 12 months after treatment. The M-FED was developed for the McKnight Foundation–sponsored studies of anorexia nervosa treatment[20] and bulimia nervosa treatment[21–24] and a 4-year longitudinal follow-up study of eating disorders.[24] The instrument captures a wide range of health care services: medical monitoring, medication management, individual therapy, group therapy, family/couples therapy, nutritional management, weight management, partial hospitalization, inpatient hospitalization, and emergency room use. The instrument was developed from the Longitudinal Interval Follow-Up Evaluation[25] with additional questions adapted from the Structured Clinical Interview for *DSM-IV* (SCID)[26] and specific questions developed for measuring medical and mental health utilization. In this trial, only the utilization portion was employed. The version of the M-FED used in this trial was revised based on experience using it to measure medical and mental health utilization in other trials (R01 MH 59234, R01 MH 058821, R01 DK 61912, and currently 2 R01 MH 058820).

Costs

Inflation did not need to be accounted for as all cost estimates were based on costs in 2013 (ie, the year the trial treatment phase closed).

Intervention costs. The cost of CBT-BN in each condition was captured by assigning the billing charge for group therapy in the 2013 Current Procedural Terminology (CPT).[27] The total per-person cost was based on the number of sessions attended by each patient.

Nonprotocol health care costs. Patient consumption of health care that was not in the study protocol was costed. For assignment of hospital inpatient costs, Diagnosis Related Grouping (DRG) diagnoses were derived from the reasons given by individuals for hospital admissions and DRG cost figures were obtained from the Center for Medicare and Medicaid Services (CMS) website (www.cms.gov). For outpatient and emergency department utilization, procedure codes were assigned using the CPT Code Book, then costs from the CMS website for these services were calculated. For medication usage, lowest mean wholesale price was obtained from the Red Book,[28] which is a drug pricing compendium aiding pharmacy operations. Costs for medication management visits were captured from the CPT Code Book.

Gas and travel time costs. Distance traveled to the clinic for face-to-face CBT-BN was based on self-report. Mean miles per gallon (MPG) was assumed from US Chamber of Commerce–Institute for 21st Century Energy data (17 miles per gallon; https://www.globalenergyinstitute.org/sites/default/files/MetricoftheMonth-NOV11MotorVehicleMPG.pdf), and mean cost of gas per gallon was assumed from US Energy Information Administration 2013 data ($3.50 North Carolina, $3.56 Pennsylvania; https://www.eia.gov/dnav/pet/PET_PRI_GND_A_EPMR_PTE_DPGAL_W.htm). Per-person gas cost was calculated as (return distance/mean MPG) × mean cost per gallon × number of sessions attended. Travel time was obtained from self-report, and hourly wage was estimated from US Census Bureau 2013 per capita annual income ($13.17/h North Carolina, $14.84/h Pennsylvania; http://quickfacts.census.gov/qfd/states/42000.html [web page now defunct; accessed September 3, 2015]). The per-person cost of time to travel to the clinic was calculated as travel time (return travel time included) × hourly wage × number of sessions attended.

Table 1. Study Demographic and Baseline Characteristics[a]

Characteristic	Face-To-Face CBT-BN (n = 90)	Internet-Based CBT-BN (n = 89)
Female	97.8 (88)	97.8 (87)
Age, mean (SD), y	27.5 (9.1)	28.5 (9.3)
White	85.6 (77)	84.3 (75)
Latino	4.4 (4)	4.5 (4)
Married/de facto	22.2 (20)	19.1 (17)
Employed	66.7 (60)	66.3 (59)
College graduate	59.6 (53)	51.7 (46)
Body mass index, mean (SD), kg/m^2	24.2 (4.7)	24.1 (5.7)
Frequency of objective binge eating in past 28 days, mean (SD)	14.1 (12.6)	16.4 (14.9)
Frequency of purging, mean (SD)	26.8 (20.7)	31.7 (34.2)
SF-6D score, mean (SD)	0.66 (0.10)	0.66 (0.09)

[a]Values shown as % (n) unless otherwise noted.
Abbreviaion: SF-6D = Short-Form Health State Classification.

Statistical Analysis

Analyses were performed in accordance with the intent-to-treat principle and conducted with SAS 9.4 (Cary, North Carolina; SAS Institute, Inc; 2016). The primary perspective for this study was a third-party payor perspective, using direct medical costs. The rationale was that direct costs have greater impact on third-party payor decisions than societal perspective costs. Additionally, there is a widespread view that eating disorder treatment is expensive, as such, cost considerations play a prominent role in third-party payor decisions about coverage of care, at least in the United States.

Data management. There were missing data at posttreatment and 1-year follow-up due to attrition. When imputing missing data, the pattern of missing data is more important than the amount missing. Missing data were assumed to be missing at random and were imputed with the expectation maximization algorithm, which produces asymptotically unbiased estimates using full-information maximum-likelihood estimation.

Third-party payor perspective. The mean cost-effectiveness ratio was calculated for each treatment arm, which is the mean cost of treatment for all subjects in an arm divided by the proportion achieving abstinence in that arm. Because the sample mean for cost data was not normally distributed, the bootstrapped mean (and 95% confidence limits [CLs]) is provided. Bootstrapping is a nonparametric procedure that simulates the normal distribution of the mean and addresses statistical uncertainty in the cost and effect estimates. Bootstrap resampling was done with

Table 2. Summary of Per-Subject Protocol and Nonprotocol Treatment Costs by Treatment Arm[a]

	Face-To-Face CBT-BN (n = 90), Mean (SD), $		Internet-Based CBT-BN (n = 89), Mean (SD), $	
Cost Variable	Posttreatment	1-Year Follow-Up	Posttreatment	1-Year Follow-Up
CBT-BN	211 (144)	211 (144)	201 (142)	200 (142)
Physician visits	60 (96)	209 (288)	71 (182)	179 (308)
Medication management	94 (184)	250 (329)	100 (198)	305 (579)
Individual therapy	110 (278)	600 (986)	291 (732)	1,023 (1,442)
Group therapy	17 (97)	38 (144)	18 (75)	41 (169)
Family/couples therapy	8 (41)	23 (94)	45 (310)	101 (520)
Nutrition counseling	41 (166)	100 (270)	17 (69)	60 (144)
Weight management	4 (28)	8 (36)	2 (10)	6 (24)
Partial hospitalization	279 (1,782)	520 (3,341)	100 (706)	192 (924)
Inpatient hospitalization	176 (934)	362 (1,755)	259 (1,490)	396 (1,679)
Emergency room	17 (41)	32 (67)	6 (19)	17 (39)
Prescription medication	775 (1,674)	1,694 (3,485)	600 (1,302)	1,546 (2,460)
Total	1,473 (2,021)	4,142 (5,608)	1,470 (1,950)	4,131 (4,046)

[a]Costs are in 2013 US dollars. CBT-BN is a per-protocol cost, and all other treatments are non-protocol costs. The "Total" cost variable has missing data imputed, for subsequent analysis. The mean (SD) values for the other cost variables were calculated based on available data.
Abbreviation: CBT-BN = cognitive-behavioral therapy for bulimia nervosa.

random replacement using 10,000 simulated samples. The mean cost-effectiveness ratio gives a base case estimate of the cost per abstinent subject.

Societal perspective. The analysis is limited by a lack of inclusion of productivity losses; hence, it is a partial societal perspective analysis. Two analyses were conducted. Firstly, we examined change in health-related quality of life from baseline to posttreatment and baseline to 1-year follow-up to give a base case estimate of dollars per QALY gained for each treatment arm. The QALYs were calculated by multiplying the SF-6D utility score by the time spent in that health state. The conventionally accepted threshold for a cost-effective treatment is $50,000/QALY, although some have advocated for $110,000–$160,000/QALY in the United States given the greater economic output.[29] For the purposes of this study, values below the $50,000 QALY threshold were considered cost-effective. Bootstrap estimates were used to generate the mean estimate and to evaluate uncertainty in cost per QALY gain estimates using 10,000 simulated samples drawn with replacement. The second analysis allowed for inclusion of the cost of patient automobile fuel and time to travel to appointments, which would differ between face-to-face and Internet-based CBT-BN.

Sensitivity analyses. For the societal perspective analysis, it is realistic to consider that patients in Internet-based treatment might be charged a software cost. It is routine to exclude software development costs from analysis. However, to be conservative, we factored in a cost of $50 per person based on the assumption that the software would be non-commercial and that this nominal amount would cover administrative tasks such as processing orders and updating/fixing bugs.

RESULTS

The 179 participants were mostly female, employed, and college graduates (Table 1). The mean (SD) number of treatment sessions was 8 (5) in both conditions. Treatment was completed (≥ 75% of sessions) by 43% (n = 39) in face-to-face and 39% (n = 35) in Internet-based CBT-BN. Costs for patients are shown in Table 2. The mean total cost for health care utilization (including protocol and nonprotocol costs) was $1,473 and $1,470 at posttreatment and $4,142 and $4,131 at 1-year follow-up, for face-to-face and Internet-based CBT-BN, respectively. Owing to the design of the study, the posttreatment cost involves a time frame of approximately 5 months and includes protocol and nonprotocol costs and the follow-up covers a time frame of approximately 12 months.

Full details of the trial and clinical outcomes have been reported.[12] Briefly, with respect to the primary outcome of abstinence, Internet-based CBT-BN was inferior to face-to-face CBT-BN at posttreatment but non-inferior at 1-year follow-up. Abstinence was attained by 21% (18/90) and 14% (12/89) at posttreatment, and 26% (18/90) and 30% (26/89) at 1 year-follow-up, in face-to-face and Internet-based CBT-BN, respectively. QALY gain is shown in Table 3. During the course of treatment, participants in each group gained on average approximately 1 week of full health. At the end of 1 year, those in face-to-face CBT-BN had gained 4 weeks of full health, and those in Internet-based CBT-BN gained 5 weeks. The clinical significance of these differences is small. It is important to note that the time horizon for measuring QALY gains (1 year) is a conservative one. The QALY gains from treatment for BN very likely extend beyond 1 year, as BN symptoms, if untreated, typically last for years, so the QALY gains from treatment very likely also accumulate over years and would thus be greater than this conservative analysis suggests.

Third-Party Payor Analysis

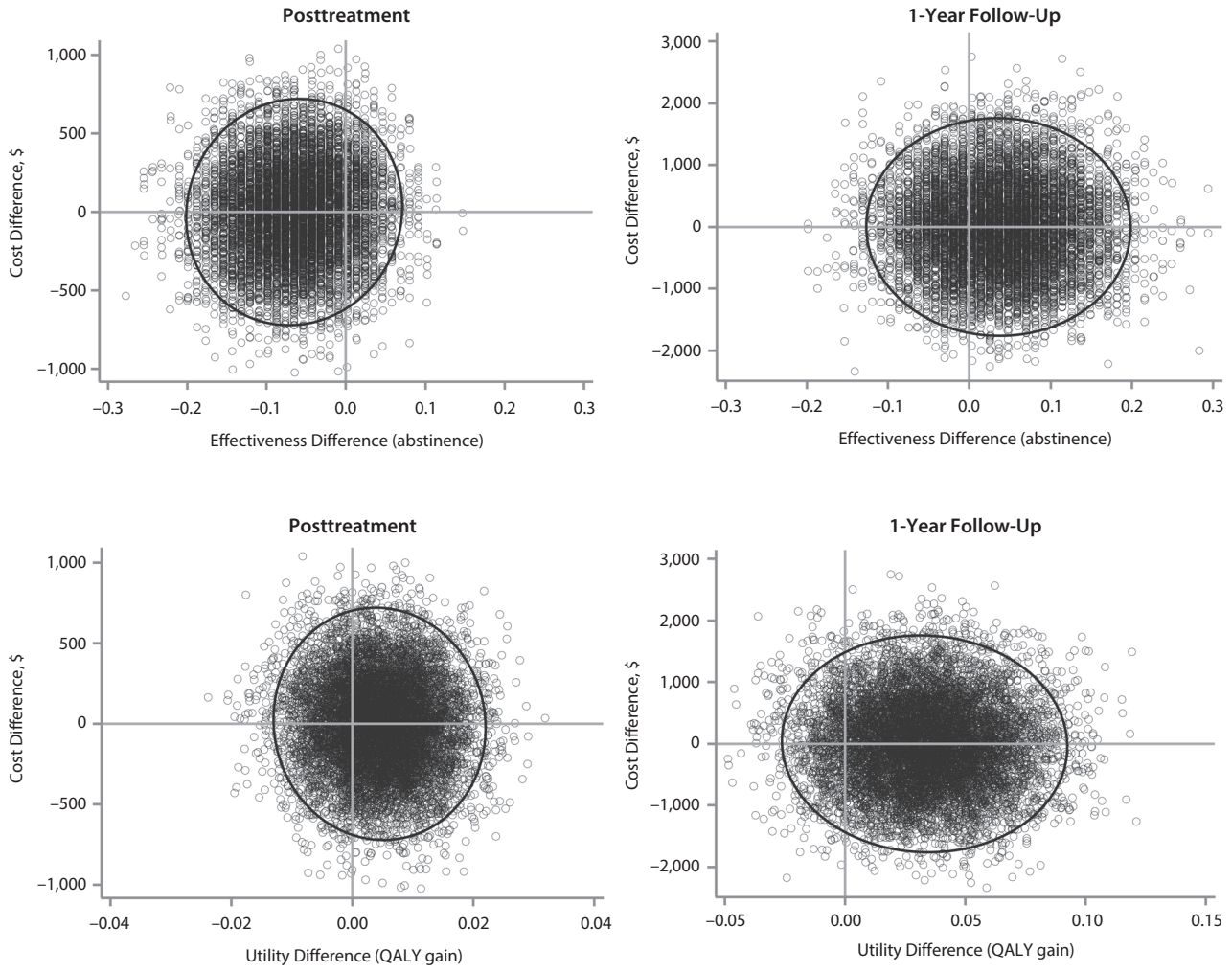
Mean cost-effectiveness ratios indicating the cost per abstinent individual for each treatment arm are shown in Table 3. At posttreatment, the cost-effectiveness ratio was

Table 3. Cost and Effectiveness of Face-To-Face and Internet-Based Cognitive-Behavioral Therapy for Bulimia Nervosa (CBT-BN)[a]

	Face-To-Face CBT-BN (n = 90)		Internet-Based CBT-BN (n = 89)	
Variable	Posttreatment	1-Year Follow-Up	Posttreatment	1-Year Follow-Up
Cost, $	1,473	4,142	1,470	4,131
Effectiveness (abstinence), proportion	0.21	0.26	0.14	0.30
Utility gain (QALYs)	0.02	0.08	0.03	0.11
Mean cost-effectiveness ratio ($/abstinence)[b]	$7,757 ($4,515, $13,361)	$16,777 ($10,298, $27,042)	$11,870 ($6,486, $22,188)	$14,561 ($10,165, $21,028)
Average cost-utility ratio ($/QALY)[b]	$73,618 ($42,580, $133,815)	$56,801 ($34,396, $96,906)	$59,540 ($36,990, $96,641)	$38,715 ($26,486, $56,739)

[a]Costs are in 2013 US dollars.
[b]The cost-effectiveness and cost-utility estimates are means and 95% confidence limits from bootstrapping analyses with 10,000 samples.
Abbreviation: QALY = quality-adjusted life-year.

Figure 1. Bootstrapped Cost and Effectiveness Estimates for Face-To-Face Versus Internet-Based Cognitive-Behavioral Therapy for Bulimia Nervosa (CBT-BN)[a]



[a]The plots at the top show the mean differences in costs and effectiveness on the primary outcome measure (Eating Disorder Examination binge and purge abstinence) using 10,000 bootstrap replicates. The plots at the bottom show the mean differences in costs and utility on quality-adjusted life-years (QALYs) gain using 10,000 bootstrap replicates. Negative cost differences indicate that internet-based CBT-BN had a lower cost estimate than face-to-face CBT-BN, and positive effectiveness (or utility) estimates indicate that internet-based CBT-BN had a higher abstinence (or QALY gain) estimate than face-to-face CBT-BN. The quadrants (clockwise from top right) represent the following scenarios for Internet-based CBT-BN compared with face-to-face CBT-BN: (1) more costly and more effective, (2) less costly and more effective (ideal), (3) less costly and less effective, and (4) more costly and less effective. The ellipse indicates the 95% confidence limits.

$7,757 for face-to-face and $11,870 for Internet-based CBT-BN. At 1-year follow-up, the cost-effectiveness ratios were $16,777 for face-to-face and $14,561 for Internet-based CBT-BN. The confidence limits for each treatment arm overlapped at posttreatment and at 1-year follow-up, signifying that there were no statistically significant differences in cost-effectiveness between the treatment arms at either time point. Figure 1 shows a scatterplot of bootstrapped cost and effect pairs presented on the incremental cost-effectiveness plane. The axes represent differences between the treatment arms in costs and effects: negative cost differences indicate that Internet-based CBT-BN had a lower cost-estimate than face-to-face CBT-BN, and positive effectiveness/utility differences mean that Internet-based CBT-BN is more effective than face-to-face CBT-BN. At posttreatment, the majority of estimates lie in the northwest quadrant (indicating that Internet-based CBT-BN is more costly and less effective than face-to-face CBT-BN) and southwest quadrant (indicating that Internet-based CBT-BN is less costly and less effective), and at follow-up, the majority lie in the northeast quadrant (indicating that Internet-based CBT-BN is more costly and more effective than face-to-face CBT-BN) and southeast quadrant (indicating that Internet-based CBT-BN is less costly and more effective). The 95% confidence ellipse contains the origin in its interior at posttreatment and 1-year follow-up, so there are no statistically significant differences in cost-effectiveness between conditions.

Societal Perspective Analysis

At posttreatment, the cost-utility ratio was $73,618/QALY for face-to-face and $59,540/QALY for Internet-based CBT-BN, and at 1-year follow-up, $56,801/QALY for face-to-face and $38,715/QALY for Internet-based CBT-BN (Table 3). Figure 1 shows bootstrapped cost and utility pairs on the incremental cost-effectiveness plane. The 95% confidence ellipse contains the origin in its interior, so there are no statistically significant differences between conditions in cost-utility at posttreatment or 1-year follow-up. Regarding practical significance, according to the predetermined threshold of $50,000/QALY, Internet-based CBT-BN was cost-effective at 1-year follow-up. At posttreatment, neither face-to-face nor Internet-based CBT-BN was cost-effective according to the practical significance threshold, and neither was face-to-face treatment at follow-up.

The mean distance traveled to the clinic by face-to-face patients was 17 miles (SD = 23), and the mean trip time was 28 minutes (SD = 23). Out-of-pocket costs of gas and travel time to attend therapy were statistically significantly different between treatment arms, as suggested by the non-overlapping CLs. At posttreatment, the mean total cost was $178 (95% CL, $127, $240) for face-to-face and nil (95% CL, $0, $0) for Internet-based participants.

Sensitivity Analysis

Out-of-pocket costs were $50 (95% CL, $50, $50) for Internet-based therapy including software versus $178 (95% CL, $127, $240) for face-to-face CBT-BN. Patients in Internet-based therapy still had significantly lower out-of-pocket costs when the software was included.

DISCUSSION

Face-to-face and Internet-based CBT-BN had similar cost-effectiveness, measured as the cost per abstinent patient. Cost-utility, measured as the cost per gain in QALYs was also comparable across intervention arms. Patient out-of-pocket costs were significantly lower in Internet-based treatment due to the absence of travel-related costs.

Although Internet-based CBT-BN was slower to achieve its effects than face-to-face CBT-BN,[12] there were no significant differences in cost-effectiveness or cost-utility at posttreatment or 1-year follow-up. This finding has implications for the dissemination of CBT-BN. Geographically remote individuals are typically at a disadvantage, as they lack the eating disorder services of their urban counterparts. Waiting lists could be reduced by being able to provide treatment at a time and location convenient to the patient (ie, work lunch hour). Further delivery formats that have had support include CBT delivered via telemedicine[30] and self-help CBT-BN with Internet support.[10] Given the lack of difference in cost-effectiveness or cost-utility, third-party payors are encouraged to provide cover for empirically supported technological solutions that increase treatment access.

Some individuals are deterred from seeking face-to-face psychotherapy because of personal barriers, including embarrassment, fear of stigma, out-of-pocket costs, social anxiety, and inconvenience.[31] Internet-based CBT-BN may be a cost-effective way of improving access to care among individuals with personal barriers. Internet-based treatment may offer more privacy than setting foot in a clinic in the community. Participants in the Internet-based arm chose the location they accessed treatment (ie, home) and logged into the group chat session with an anonymous username and password that concealed their identity from other group members. Internet-based CBT-BN was associated with out-of-pocket cost savings.

There were modest gains in QALYs at posttreatment, which is not surprising given the short time-frame, and at 1-year follow-up. The QALY measure showed less sensitivity than the treatment effect measure of abstinence. Results supported the cost-utility of Internet-based CBT-BN at 1-year follow-up, but not face-to-face CBT-BN according to the conventionally used threshold, although no statistically significant differences between the 2 treatment arms were found. Although scores increased over time, the mean baseline, posttreatment, and 1-year follow-up SF-6D utility scores in each condition fell significantly below reported norms (approximately 0.8 for this age group),[32,33] highlighting the toll of bulimia nervosa. The choice of a cost-utility threshold is a value judgment that depends on several factors; some decision-makers may conclude that these 2 interventions are reasonably cost-effective. The

estimates fell well within the limit of US $160,000 per year, above which few decision-makers would find acceptable. The analyses were performed from a partial societal perspective, as costs of productivity loss due to illness were not captured.

Abstinence rates seem to increase in the Internet-based arm while decreasing in the face-to-face arm between posttreatment and 1 year, whereas costs are comparable in both groups. It could be that individuals in the Internet-based arm were reviewing therapy materials more frequently after treatment than those in the face-to-face arm, as they had online access to materials.

This study has important strengths, including being the first study known to us to compare and calculate the cost-effectiveness of Internet-based CBT-BN versus face-to-face CBT-BN. Strengths also include the rigor of therapy and clinical assessment and the wide range of nonprotocol health care utilization captured. Several limitations are apparent. Attrition increased during the course of the study, and at 1-year follow-up the present sample may not have been large enough for missing data imputation. Simulation studies[34] suggest that full information maximum likelihood imputation in general produces unbiased estimates; however, large samples (ie, 500) may be required to reveal the asymptotic distribution when attrition is higher. Wider measures of societal perspective costs were unavailable. Workplace costs due to productivity losses and further out-of-pocket expenditures by the patient and caregivers (ie, copayments, prescription medications, binge/purge food costs, diet and purging aid costs, child care expenses, and gas and travel time costs to attend nonprotocol health care) are examples. These most likely constitute an important part of the societal costs but are more difficult to measure. In addition, carefully tracking some costs (ie, cost of binge food) might impact symptom levels, confounding their accurate measurement in trials. A common argument for studying Internet-based interventions is that they are likely to cost less because of savings in clinic operating costs (ie, administrative labor, overheads), but because these costs are not easily estimated and because the services that clinics choose to offer are heavily influenced by third-party payor decisions, it was deemed most useful to adopt a third-party payor perspective for the present study. Most participants lived within readily traveled distances to the clinic, so the travel costs underestimate the costs for patients who live further from services. Furthermore, many people would simply not access treatment from substantial distance. Even so, such individuals would remain at risk for medical complications and higher rates of other kinds of medical utilization.

This study supports Internet-based CBT-BN as a comparably cost-effective treatment to an accepted standard, ie, face-to-face CBT-BN. Third-party payors are urged to develop and implement reimbursement schedules that increase access to effective treatment, and therapists and specialist services are encouraged to consider technologically innovative models of care.

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