OREGON HEALTH AND SCIENCE UNIVERSITY

OFFICE OF CLINICAL INTEGRATION AND EVIDENCE-BASED PRACTICE

Evidence-Based Practice Summary

Cost-effectiveness of comprehensive obesity management program

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ASK THE QUESTION

Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?

Background: The prevalence of obesity, which is defined as a body mass index (BMI) of greater than 30, has increased dramatically in the United States since the late 1990s (Ringel 2004). Currently, rates of obesity exceed 30% in most sex and adult age groups, whereas prevalence among children and adolescents, defined as a BMI of more than 95th percentile, has reached 17% (Flegal 2010).) As BMI increases, there are significant increases in physician visits, emergency department visits, and health care costs, as well as impairment in work productivity (DiBonaventura 2015). The alarming rates of the high prevalence of obesity have posed a significant public health concern as well as a substantial financial burden on our society because obesity is known to be a risk factor for many chronic diseases, such as type 2 diabetes, cancer, hypertension, asthma, myocardial infarction, stroke and other conditions (Hu 2008; Dixon 2010).

SEARCH FOR EVIDENCE

Databases included Ovid MEDLINE, Cochrane Database of Systematic Reviews, PsycINFO, and National Guideline Clearinghouse, also looked at references and citing articles

Search strategy included:

1. exp Obesity/dh, dt, nu, su, th [Diet Therapy, Drug Therapy, Nursing, Surgery, Therapy] (45078)
2. exp weight loss/ (36510)
3. (obes* or overweigh* or overnutrition or heavy).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (411617)
4. 2 and 3 (18901)
5. 1 or 4 (51769)

6. exp Patient Care Team/ (63727)
7. exp Comprehensive Health Care/ (272153)
8. 6 or 7 (322250)
9. 5 and 8 (1310)
10. exp obesity/ (182823)
11. 8 and 10 (2364)
12. exp "Costs and Cost Analysis"/ (214842)
13. 11 and 12 (95)
14. exp obesity/ec (1647)
15. 8 and 14 (66)
16. 13 or 15 (117)
17. ((cost* or expens* or financ* or dollar* or reimburs*) adj10 ((comprehensiv* or team* or interdiscip* or inter-discip* or interprofession* or inter-profession*) adj7 ((obes* or overweigh* or weigh*) adj3 (manag* or treat* or therap* or interven* or program* or system* or counsel*)))).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (7)
18. ((cost* or expens* or financ* or dollar* or reimburs*) adj10 ((comprehensiv* or team* or interdiscip* or inter-discip* or interprofession* or inter-profession*) adj7 ((lose* or loss* or losing or reduc* or drop* or shed* or manag*) adj3 weigh*) adj3 (manag* or treat* or therap* or interven* or program* or system* or counsel*))).mp. (3)
19. 16 or 17 or 18 (123)
20. exp Economics/ (560532)
21. ec.fs. (392168)
22. 20 or 21 (683247)
23. 9 and 22 (101)
24. 19 or 23 (156)
25. limit 24 to english language (144)
26. limit 24 to abstracts (124)
27. 25 or 26 (152)

Filters/limits included systematic reviews published in English in the last 10 years.

CRITICALLY ANALYZE THE EVIDENCE

The literature search resulted in a number of studies evaluating the cost-effectiveness of various interventions. In order to simplify the review process, we grouped the evidence into five categories: (1) Bariatric Surgery; (2) Pharmacologic; (3) Behavioral; (4) Primary Care Weight Management Program; and (5) Lifestyle Intervention.

Bariatric Surgery: Four studies were found that evaluated the cost-effectiveness of bariatric surgery, one systematic review and three non-randomized studies. The systematic review (Campbell 2016) included 77 studies in 17 countries, with 56% studies were conducted in the United States. Incremental cost-effectiveness ratios (cost/QALY gained) for cost utility studies which reported in USD revealed base-care valuations of </= $6,500/QALY gained. One simulation model study (Hoerger 2010) analyzed the cost-effectiveness of bariatric surgery in severely obese (BMI > or = 35 kg/m2) adults with diabetes. The study found that bypass surgery had cost-effectiveness ratios of $7,000/QALY and $12,000/QALY for severely obese patients with newly diagnosed and established diabetes respectively. Banding surgery had cost-effectiveness ratios of $11,000/QALY and $13,000/QALY for the respective groups. A retrospective study (McEwen 201) assessed the cost, quality of life impact, and the cost-utility of bariatric surgery in a managed care population. The study found the cost-utility ratio for bariatric surgery versus no surgery was approximately $1,400 per QALY. Finally, a retrospective cohort study (Warren 2015) created a model on the cost-effectiveness of increasing the number of bariatric surgical operations performed on patients with Type II Diabetes Mellitus (T2DM). The 10-year aggregate cost savings of bariatric surgery compared with a control group is $2.7 million/1000 patients; the total (direct and indirect) cost savings is $5.4 million/1000 patients.
Quality of Evidence: Moderate

Pharmacologic: Two studies were found evaluating the cost-effectiveness of pharmacologic interventions in patients considered obese. One systematic review (Ara 2012) in the United Kingdom evaluated the clinical effectiveness and cost-effectiveness of three pharmacological interventions. The study found a large variation in the results reported in the 16 identified published economic evaluations with incremental cost-effectiveness ration (ICERs) ranging from £ 970 to £ 59,174 per QALY when comparing the active interventions with lifestyle advice. A retrospective study (Counterweight Project 2008) quantified the influence of body mass index (BMI) on prescribing costs, and then the potential savings attached to implementing a weight management intervention, known as the Counterweight Weight Management Program. Modelling weight reductions achieved by the program would potentially reduce prescribing costs by pound 6.35 (men) and pound 3.75 (women) or around 8% of program costs at one year, and by pound 12.58 and pound 8.70, respectively, or 18% of program costs after two years of intervention.
Quality of Evidence: Low

Behavioral: Two studies were found evaluating the cost-effectiveness of behavioral interventions. One economic evaluation study (Hoerger 2015) examined the potential cost effectiveness of Medicare's intensive behavioral therapy for obesity. Based on assumptions for the maximal intervention effectiveness, intensive behavioral therapy is likely to be cost saving if costs per session equal the current reimbursement rate ($25.19) and will provide a cost-effectiveness

ratio of $20,912 per quality-adjusted life-year if costs equal the rate for routine office visits. A RCT (Quattrin 2017) reported the cost-effectiveness of long-term weight change for family-based behavioral treatment (FBT) compared with an attention-controlled information control (IC) group. The incremental cost-effectiveness ratios (ICERs) for children and parents' %OBMI were $116.1 and $83.5 per U of %OBMI, respectively. Parental ICERs were also calculated for body weight and BMI and were $128.1 per 1, and $353.8/per kilogram, respectively.
Quality of Evidence: Low

Primary Care Weight Management Program: Three non-randomized studies evaluated the cost-effectiveness of primary care weight management programs. One cross-sectional study (Tigbe 2013) quantified the relationship between BMI and total healthcare expenditure with the patient as the unit of analysis. Adjusted total annual healthcare cost was £16 (95% CI 11-21) higher per unit BMI. All cost categories were significantly (P<0.003) higher for those with BMI >40 compared with BMI <20kgm (-2): prescription drugs (men: £390 versus £16; women: £211 versus £73), hospitalization (men: £72 versus £0; women: £243 versus £107), primary care (men: £191 versus £69; women: £268 versus £153) and outpatient care (£234 versus £107 women only). A retrospective study (Trueman 2010) evaluated the long-term cost-effectiveness through its potential to reduce obesity-related conditions and associated healthcare resource use, with improved health outcomes. Quality-adjusted Life-Year cost was £2017 where background weight gain was limited to 0.5 kg/year, and £2651 at 0.3 kg/year. Another retrospective study (Tsai 2013) conducted an economic analysis of a clinical trial of obesity treatment that was implemented in six primary care practices. The incremental cost per kilogram-year lost was $292 for Enhanced Brief LC compared to Usual Care (95% CI $38 to $394). The incremental cost per QALY was $115,397, but the 95% CI were undefined.
Quality of Evidence: Low

Lifestyle Intervention: One RCT (Wolf 2007) evaluated the program and health care costs of a lifestyle intervention in a high-risk obese population. The study found that net cost of the intervention was $328 per person per year. After incorporating program costs, mean health plan costs were $3,586 (95% confidence interval [CI]: -$8,036, -$25, P<0.05) lower in case management compared to usual care.
Quality of Evidence: Low

In conclusion, there is moderate to low quality of evidence on the cost-effectiveness of obesity interventions. The majority of modalities (Pharmacologic; Behavioral; Primary Care Weight Management Program; and Lifestyle Intervention) were rated low due to inconsistency because of variation in interventions and economic evaluations, and due to imprecision when studies included few patients and/or events. Additionally, the bariatric surgery modality was rated as moderate overall. Another limitation in the evidence is that the studies looked at individual interventions rather than the cost-effectiveness of a comprehensive obesity center that includes all modalities.

PICO Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?						Lower Quality Rating if: ☐ Studies inconsistent (*wide variation of treatment effect across*
Modality: Bariatric Surgery; **Outcome:** Cost-Effectiveness						
Author/Date	*Purpose of Study*	*Study Design & Methods*	*Sample*	*Outcomes*	*Design Limitations*	

Total # of Studies: 4 # of Systematic Reviews:1 # of Non-Randomized Studies: 3						*studies, populations, interventions, or outcomes varied)* ☐ Studies are indirect *(PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)* ☐ Studies are imprecise (*When studies include few patients and few events and thus have wide confidence intervals and the results are uncertain)* ☐ Publication Bias *(e.g. pharmaceutical company sponsors study on effectiveness of drug, only small, positive studies found)* <u>Increase Quality Rating if:</u> ☐ Large Effect ☐ Dose-response gradient ☐ Plausible confounders or other biases increase certainty of effect
Campbell, J.A., et al., 2016, *Obesity Reviews*	To summarize and synthesize a diverse range of economic evaluations on bariatric surgery	Systematic Review; Multiple perspectives	77 studies representing 17 countries (56% USA)	Despite study heterogeneity, common themes emerged, and important gaps were identified. Most studies adopted the healthcare system/third-party payer perspective; reported costs were generally healthcare resource use (inpatient/ shorter-term outpatient). Out-of-pocket costs to individuals, family members (travel time, caregiving) and indirect costs due to lost productivity were largely ignored. Costs due to reoperations/complications were not included in one-third of studies. Body-contouring surgery included in only 14%. One study evaluated long-term waitlisted patients. Surgery was cost-effective/cost-saving for severely obese with type 2 diabetes mellitus. Study quality was inconsistent. **Incremental cost-effectiveness ratios (cost/QALY gained) for cost utility studies that reported in USD from 2010 to 2014 revealed base-case valuations of ≤ $6,500/QALY gained**. One study was an exception and reported $17,300/QALY gained for ORYGBP (an open procedure). These valuations still fall well below the accepted willingness to pay threshold of ≤$50,000/QALY	Study Limitations = ☐ None ***Systematic Review*** ☐ Review did not address focused clinical question ☐ Search was not detailed or exhaustive ☒ Quality of the studies was not appraised or studies were of low quality ☒ Methods and/or results were inconsistent across studies
Hoerger, T.J., et al, 2010, *Diabetes Care*	To analyze the cost-effectiveness of bariatric surgery in severely obese (BMI >or=35 kg/m(2)) adults who have diabetes, using a validated diabetes cost-effectiveness model	Simulation Model; Societal The Centers for Disease Control and Prevention–RTI Diabetes Cost-Effectiveness Model was expanded to incorporate bariatric surgery. Model estimated the costs, quality-adjusted life-years (QALYs), and cost-effectiveness of gastric bypass surgery relative to usual diabetes care and of gastric banding surgery relative to usual diabetes care. The cost-effectiveness of each type of surgery for severely obese		In all analyses, bariatric surgery increased QALYs and increased costs. **Bypass surgery had cost-effectiveness ratios of $7,000/QALY and $12,000/QALY for severely obese patients with newly diagnosed and established diabetes, respectively. Banding surgery had cost-effectiveness ratios of $11,000/QALY and $13,000/QALY for the respective groups.** In sensitivity analyses, the cost-effectiveness ratios were most affected by assumptions about the direct gain in QoL from BMI loss following surgery.	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated

		individuals who are newly diagnosed with diabetes and for severely obese individuals with established diabetes.		*Table 2—Life-years gained and cost-effectiveness ratios (relative to no surgery) for baseline analyses* Total costs* / Remaining life-years / QALYs* / Cost-effectiveness ratio ($/QALY)† Patients with newly diagnosed diabetes No surgery (standard care) $71,130 21.62 9.55 Bypass surgery $86,665 23.34 11.76 Incremental (vs. no surgery) $15,536 1.72 2.21 $7,000 Banding surgery $89,029 22.76 11.12 Incremental (vs. no surgery) $17,900 1.14 1.57 $11,000 Patients with established diabetes No surgery $79,618 16.86 7.68 Bypass surgery $99,944 17.95 9.38 Incremental (vs. no surgery) $20,326 1.09 1.70 $12,000 Banding surgery $96,921 17.80 9.02 Incremental (vs. no surgery) $17,304 0.94 1.34 $13,000 *Costs and QALYs are discounted at a 3% annual rate. †Cost-effectiveness ratios are rounded to the nearest $1,000/QALY.	☐ The methods for the estimation of quantities and unit costs are not described	Quality (certainty) of evidence for studies as a whole: ☐ High ☒ Moderate ☐ Low ☐ Very Low
McEwen, L.N., et al., 2010, *Obesity Surgery*	To assess the cost, quality of life impact, and the cost-utility of bariatric surgery in a managed care population	Retrospective Study; Payer Studied patients who underwent bariatric surgery. Medical claims data were reviewed for 18 months before and 24 months after the date of bariatric surgery, and patients were surveyed approximately 12 months after they underwent bariatric surgery.	221 patients	One year after surgery, mean body mass index fell from 51 to 31 kg/m(2) in women and from 59 to 35 kg/m(2) in men with substantial improvements in comorbidities. Postsurgical mortality and morbidity were low. Total per member per month costs increased in the 6 months before bariatric surgery, were lower in the 12 months after bariatric surgery, but increased somewhat over the next 12 months. When presurgical quality of life was assessed prospectively, average health utility scores improved by 0.14 one year after surgery. In analyses that took a lifetime time horizon, **projected future costs based on age and obesity and discounted costs and health utilities at 3% per year, the cost-utility ratio for bariatric surgery versus no surgery was approximately $1,400 per quality-adjusted life-year gained**. In sensitivity analyses, bariatric surgery was more cost-effective in women, non-whites, more obese patients, and when performed laparoscopically. Although not cost-saving, bariatric surgery represents a very good value for money.	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

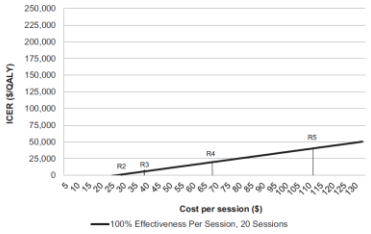
				Table 4 Cost–utility of bariatric surgery Scenario 1 Bariatric surgery / Scenario 2 No bariatric surgery 2-year time horizon 2-year costs $23,908 / $10,282 2-year QALYs 1.76 / 1.48 ΔCost $13,626 ΔQALY 0.28 ΔCost/ΔQALY $48,662 Lifetime time horizon[a] Lifetime costs $83,813 / $81,308 Lifetime QALYs 9.95 / 8.19 ΔCost $2,505 ΔQALY 1.76 ΔCost/ΔQALY $1,425 [a] Costs and QALYs discounted at 3% per year		
Warren, J.A., et al, 2015, *American Surgeon*	To develop a model on the cost-effectiveness of increasing the number of bariatric surgical operations performed on patients with Type II diabetes mellitus (T2DM) in the United States	Retrospective Cohort Study; Societal Applied published population cost estimates (2012) for medical care of T2DM to a retrospective cohort of morbidly obese patients in South Carolina. Study compared differences in 10-year medical costs between those having bariatric surgery and controls.	371,200 people	Resolution of T2DM in the bariatric cohort was assumed to be 40 per cent. Considering only the direct medical costs of T2DM**, the 10-year aggregate cost savings compared with a control group is $2.7 million/1000 patients; the total (direct and indirect) cost savings is $5.4 million/1000 patients**. When considering resolution of T2DM alone, increasing the number of bariatric operations for a given population leads to a substantial cost savings over a 10-year period.	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

PICO Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?						Lower Quality Rating if:
Modality: Pharmacologic; **Outcome:** Cost-Effectiveness						☒ Studies inconsistent (*wide variation of treatment effect across studies, populations, interventions, or outcomes varied)*
Author/Date	*Purpose of Study*	*Study Design & Methods*	*Sample*	*Outcomes*	*Design Limitations*	☐ Studies are indirect *(PICO question is quite different from the*
Total # of Studies: 2 # of Systematic Reviews: 1 # of Non-Randomized Studies: 1						
Ara, R., et al, *Health Technology Assessment*	To evaluate the clinical effectiveness and cost-effectiveness of three	Systematic Review; Societal	94 studies involving 24,808 individuals were included in the clinical meta-analysis	**There was a large variation in the results reported in the 16 identified published economic evaluations with incremental cost-effectiveness ration (ICERs) ranging from £970 to £59,174 per QALY when comparing the active interventions with lifestyle advice**. Only one study compared	Study Limitations = ☐ None ***Systematic Review*** ☐ Review did not address focused clinical question ☐ Search was not detailed or exhaustive	

(Winchester, England), 2012	pharmacological interventions in obese patients			the active pharmacological interventions and the reported results suggested that rimonabant would be considered cost effective compared with either orlistat or sibutramine. These analyses were conducted before the withdrawal of both rimonabant and sibutramine. The results of the deterministic analyses conducted for the current study show that, compared with placebo, sibutramine 15 mg dominates (the average costs are lower and the average QALYs are higher) the other three active interventions. However, sibutramine and rimonabant have both been withdrawn because of safety concerns relating to potential treatment-induced fatal adverse events. **When considering the potential increase in mortality, the treatments would no longer be considered cost-effective using a threshold of £20,000 per QALY if the proportion of patients who experienced a fatal adverse event was > 1.8% (1.5%, 1.0%) for sibutramine 15 mg (sibutramine 10 mg, rimonabant).** **Comparing orlistat with placebo, orlistat would be considered cost-effective when using a threshold of £20,000 per QALY and the model is robust to variations in the key parameter values tested with the exception of the baseline BMI value.**	☒ Quality of the studies was not appraised or studies were of low quality ☐ Methods and/or results were inconsistent across studies	*available evidence in regard to population, intervention, comparison, or outcome)* ☐ Studies are imprecise (*When studies include few patients and few events and thus have wide confidence intervals and the results are uncertain)* ☐ Publication Bias *(e.g. pharmaceutical company sponsors study on effectiveness of drug, only small, positive studies found)* <u>Increase Quality Rating if:</u> ☐ Large Effect ☐ Dose-response gradient ☐ Plausible confounders or other biases increase certainty of effect
Counterweight Project, T., *Journal of Health Services & Research Policy*, 2008	To quantify the influence of body mass index (BMI) on prescribing costs, and then the potential savings	Retrospective Study; Payer Paper and computer-based medical records were reviewed for all drug prescriptions over an 18-month period for randomly selected adult patients (18-75 years) stratified by BMI, from 23 primary care practices	3,400 adults	The minimum annual cost of all drug prescriptions at BMI 20 kg/m(2) was pound 50.71 for men and pound 62.59 for women. Costs were greater by pound 5.27 (men) and pound 4.20 (women) for each unit increase in BMI, to a BMI of 25 (men pound 77.04, women pound 78.91), then	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer)	Quality (certainty) of evidence for studies as a whole: ☐ High ☐ Moderate ☒ Low ☐ Very Low

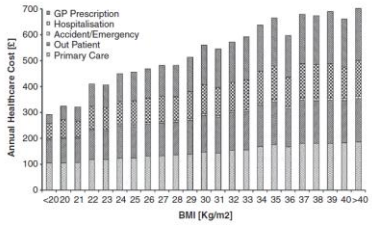
	attached to implementing a weight management intervention	in seven UK regions. Drug costs from the British National Formulary at the time of the review were used. Multivariate regression analysis was applied to estimate the cost for all drugs and the 'top ten' drugs at each BMI point. This allowed the total and attributable prescribing costs to be estimated at any BMI. Weight loss outcomes achieved in a weight management program (Counterweight) were used to model potential effects of weight change on drug costs. Anticipated savings were then compared with the cost program delivery. Analysis was carried out on patients with follow-up data at 12 and 24 months as well as on an intention-to-treat basis. Outcomes from Counterweight were based on the observed lost to follow-up rate of 50%, and the assumption that those patients would continue a generally observed weight gain of 1 kg per year from baseline.		by pound 7.78 and pound 5.53, respectively, to BMI 30 (men pound 115.93 women pound 111.23), then by pound 8.27 and pound 4.95 to BMI 40 (men pound 198.66, women pound 160.73). The relationship between increasing BMI and costs for the top ten drugs was more pronounced. Minimum costs were at a BMI of 20 (men pound 8.45, women pound 7.80), substantially greater at BMI 30 (men pound 23.98, women pound 16.72) and highest at BMI 40 (men pound 63.59, women pound 27.16). Attributable cost of overweight and obesity accounted for 23% of spending on all drugs with 16% attributable to obesity. The cost of the program was estimated to be approximately pound 60 per patient entered. **Modelling weight reductions achieved by the Counterweight weight management program would potentially reduce prescribing costs by pound 6.35 (men) and pound 3.75 (women) or around 8% of program costs at one year, and by pound 12.58 and pound 8.70, respectively, or 18% of program costs after two years of intervention.** Potential savings would be increased to around 22% of the cost of the program at year one with full patient retention and follow-up.	☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

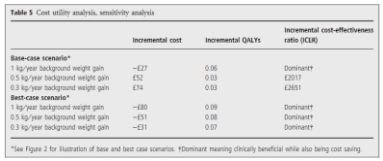
PICO Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?						Lower Quality Rating if: ☒ Studies inconsistent (*wide variation of treatment effect across studies, populations,*
Modality: Behavioral; **Outcome:** Cost-Effectiveness						
Author/Date	*Purpose of Study*	*Study Design & Methods*	*Sample*	*Outcomes*	*Design Limitations*	
Total # of Studies: 2 # of RCTs: 1 # of Non-Randomized Studies: 1						

Hoerger, T.J., et al., *American Journal of Preventive Medicine*, 2015	To examine the potential cost effectiveness of Medicare's intensive behavioral therapy for obesity, accounting for uncertainty in effectiveness and utilization	Economic Evaluation Study; Payer A Markov simulation model of type 2 diabetes was used to estimate long-term health benefits and healthcare system costs of intensive behavioral therapy for obesity in the Medicare population without diabetes relative to an alternative of usual care. Medicare covers weekly visits for the first month and biweekly visits for the next 5 months of the intervention. If the patient achieves weight loss >/= 3 kg after 6 months, Medicare will fund monthly visits for 6 additional months, for a total of 20 intervention sessions over 12 months. These visits must last at least 15 minutes and were reimbursed at $25.19 per session in 2012.	The analysis assumed that the intervention would be applied to a cohort of Medicare beneficiaries with obesity. The simulation cohort was based on nationally representative data from people aged > 65 years with BMI > 30 in the 2005–2008 National Health and Nutrition Examination Survey (NHANES).	**Based on assumptions for the maximal intervention effectiveness, intensive behavioral therapy is likely to be cost saving if costs per session equal the current reimbursement rate ($25.19) and will provide a cost-effectiveness ratio of $20,912 per quality-adjusted life-year if costs equal the rate for routine office visits.** The intervention is less cost effective if it is less effective in primary care settings or if fewer intervention sessions are supplies by providers or used by participants. 	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	*interventions, or outcomes varied)* ☐ Studies are indirect *(PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)* ☒ Studies are imprecise (*When studies include few patients and few events and thus have wide confidence intervals and the results are uncertain)* ☐ Publication Bias *(e.g. pharmaceutical company sponsors study on effectiveness of drug, only small, positive studies found)* <u>Increase Quality Rating if:</u> ☐ Large Effect ☐ Dose-response gradient ☐ Plausible confounders or other biases increase certainty of effect
Quattrin, T., et al., *Pediatrics*, 2017	To report the cost-effectiveness of long-term weight change for family-based behavioral treatment (FBT) compared with an attention-controlled information control (IC) group	RCT; Societal Children 2 to 5 years of age with overweight or obesity and with parents who had a BMI >/= 25 were randomly assigned to FBT or IC, and both received diet and activity education (12-month treatment and 12-month follow-up). Weight loss and cost-effectiveness were assessed at 24 months. Intention-to-treat, completes, and sensitivity analyses were performed.	Ninety-six children	The average societal cost per family was $1,629 for the FBT and $886 for the IC groups at 24 months. At 24 months, child percent over BMI (%OBMI) change decreased by 2.0 U in the FBT group versus an increase of 4.4 U in the IC group. Parents lost 6.0 vs 0.2 kg at 24 months in the FBT and IC groups, respectively**. The incremental cost-effectiveness ratios (ICERs) for children and parents' %OBMI were $116.1 and $83.5 per U of %OBMI, respectively. Parental ICERs were also calculated for body weight and BMI and were $128.1 per 1, and $353.8/per kilogram, respectively.** ICER values for child %OBMI were similar in the intention-	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

				to-treat group ($116.1/1 U decrease) compared with completers ($114.3). TABLE 3 Social Costs Including Treatment Costs (Payers) and Opportunity Costs (Participating Families) Costs That Occurred Between Months 0 and 24 for FBT and IC Groups FBT / IC Treatment costs (payers): Teaching $3629 $3629; Weight station $536 $359; Caregivers $6840 $3420; Counseling $5688 $0; Supervision $16 861 $4210; Materials and preparation $7612 $2541; Make-up sessions $2098 $1799; Staff fuel costs $7131 $4729; Staff travel time $5717 $3523; Total costs (payers) $56 112 $24 210; Cost per family (payers) $1220 $484 Opportunity costs (participants costs): Fuel $1554 $1623; Travel time $1568 $2199; Treatment time $12 334 $13 377; Treatment time make-ups $3360 $2880; Total costs (participants) $18 816 $20 079; Societal costs $74 928 $44 289; Societal cost per family $1629 $886 TABLE 6 Costs, Changes in Child %BMI and Parent BMI, Body Weight (kg) and %BMI, and ICER From 0 to 24 mo for FBT and ICs With Uncertainty Estimates 95% CI (Completers n = 70) Cost ($) / Incremental Cost ($) / Changes: FBT / IC / Effect / ICER	Quality (certainty) of evidence for studies as a whole: ☐ High ☐ Moderate ☒ Low ☐ Very Low

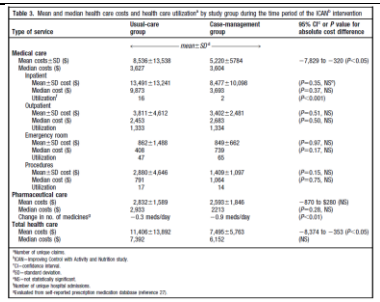
PICO Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?						Lower Quality Rating if:
Modality: Primary Care Weight Management Program; **Outcome:** Cost-Effectiveness						
Author/Date	*Purpose of Study*	*Study Design & Methods*	*Sample*	*Outcomes*	*Design Limitations*	
Total # of Studies: 3 # of Non-Randomized Studies: 3						
Tigbe, W.W., et al., *International Journal of Obesity*, 2013	To quantify the relationship between BMI and total healthcare expenditure, with the patient as the unit of analysis	Cross-sectional study; Healthcare expenditure Analyses of data, collected over 18-months in 2002-2003, from 3324 randomly selected patients, in 65 general practices across UK. Healthcare costs estimated from primary care, outpatient, accident/emergency and hospitalization attendances, weighted by unit costs taken from standard sources.	3,324 patients	In univariate analyses, significant associations (P<0.05) were found between total healthcare expenditure and all dependent variables (women>men, drinker<non-drinkers, smokers>non-smokers, and increasing with greater physical activity, age and BMI. In multivariate analysis, age, sex, BMI, smoking and alcohol consumption remained significantly associated with healthcare cost, and together explained just 9% of the variance in healthcare expenditure. **Adjusted total annual healthcare cost was 16 pounds (95% CI 11-21) higher per unit BMI. All cost categories were significantly (P<0.003) higher for those with BMI >40 compared with BMI <20kgm (-2): prescription drugs**	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	☒ Studies inconsistent (*wide variation of treatment effect across studies, populations, interventions, or outcomes varied)* ☐ Studies are indirect *(PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)* ☐ Studies are imprecise (*When studies include few patients and few events and thus have wide*

				(men: 390 versus 16; women: 211 versus 73), hospitalization (men: 72 versus 0; women: 243 versus 107), primary care (men: 191 versus 69; women: 268 versus 153) and outpatient care (234 versus 107 women only).  		*confidence intervals and the results are uncertain)* ☐ Publication Bias *(e.g. pharmaceutical company sponsors study on effectiveness of drug, only small, positive studies found)* <u>Increase Quality Rating if:</u> ☐ Large Effect ☐ Dose-response gradient ☐ Plausible confounders or other biases increase certainty of effect Quality (certainty) of evidence for studies as a whole: ☐ High ☐ Moderate ☒ Low ☐ Very Low
Trueman, P., et al, *International Journal of Clinical Practice,* 2010	To evaluate the long-term cost-effectiveness through its potential to reduce obesity-related conditions and associated healthcare resource use, with improved	Retrospective Study; Societal Using the 2006 National Institute of Clinical Excellence (NICE) obesity health economic model, a primary care weight management program (Counterweight) was analyzed, evaluating costs and outcomes associated with weight gain for three obesity-related conditions (type 2 diabetes, coronary heart disease, colon cancer). Sensitivity	1,906 patients	Mean weight changes in Counterweight attenders was -3 kg and -2.3 kg at 12 and 24 months, both 4 kg below the expected 1 kg/year background weight gain. Counterweight delivery cost was £59.83 per patient entered. Even assuming drop-outs/non-attenders at 12 months (55%) lost no weight and gained at the background rate, Counterweight was 'dominant' (cost-saving) under 'base-case scenario', where 12-month achieved weight loss was entirely regained over the	Study Limitations = ☐ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated	

	health outcomes	analyses examined different scenarios of weight loss and background (untreated) weight gain.		next 2 years, returning to the expected background weight gain of 1 kg / year. **Quality-adjusted Life-Year cost was £2017 where background weight gain was limited to 0.5 kg / year, and £2651 at 0.3 kg / year.** Under a 'best-case scenario', where weights of 12-month-attenders were assumed thereafter to rise at the background rate, 4 kg below non-intervention trajectory (very close to the observed weight change), Counterweight remained 'dominant' with background weight gains 1 kg, 0.5 kg or 0.3 kg / year.  Table 5 Cost utility analysis, sensitivity analysis Incremental cost / Incremental QALYs / Incremental cost-effectiveness ratio (ICER) Base-case scenario* 1 kg/year background weight gain −£27 0.06 Dominant† 0.5 kg/year background weight gain £52 0.03 £2017 0.3 kg/year background weight gain £74 0.03 £2651 Best-case scenario* 1 kg/year background weight gain −£80 0.09 Dominant† 0.5 kg/year background weight gain −£51 0.08 Dominant† 0.3 kg/year background weight gain −£31 0.07 Dominant† *See Figure 2 for illustration of base and best case scenarios. †Dominant meaning clinically beneficial while also being cost saving. **Table 6** Cost-effectiveness ratios of intervention recommended by the NICE (2006) guidelines on obesity. The wide ranges of values quoted can be partly explained by differences in populations considered in the published studies of weight management interventions **Interventions** / **Cost/QALY range** Surgery £6289 to £8527 Pharmacotherapy £6349 to £24,431 Non-pharmacological approaches (diet and physical activity-based lifestyle change) £174 to £9971 Public Health interventions £265 to £3018	☒ The methods for the estimation of quantities and unit costs are not described	
Tsai, A.G., et al., *International Journal of Obesity*, 2013	To conduct an economic analysis of a clinical trial of obesity treatment that was implemented in	Retrospective Study; Payer Conducted within-trial cost-effectiveness analysis of a primary care-based obesity intervention. Study participants were randomized to: Usual Care (quarterly visits with their primary care provider); Brief Lifestyle Counseling (Brief LC;	390 individuals	Weight losses after 2 years were 1.7, 2.9, and 4.6 kg for Usual Care, Brief LC, and Enhanced Brief LC, respectively (p = 0.003 for comparison of Enhanced Brief LC vs. Usual Care). **The incremental cost per kilogram-year lost was $292 for Enhanced Brief LC compared to Usual Care (95% CI $38 to $394). The incremental cost per QALY was $115,397, but the 95% CI were**	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer)	

	six primary care practices	quarterly provider visits plus monthly weight loss counseling visits; or Enhanced Brief Lifestyle Counseling (Enhanced Brief LC; all above interventions, plus choice of meal replacements or weight loss medication). A health care payer perspective was used. Intervention costs were estimated from tracking data obtained prospectively. Quality adjusted life years (QALYs) were estimated with the EuroQol-5D. Estimated cost per kilogram-year of weight loss and cost per QALY		**undefined.** Comparison of short term cost per kg with published estimates of longer term cost per QALYs suggested that the intervention could be cost-effective over the long term (>/=10 years).	☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

PICO Question: In adult patients considered obese (BMI >/=30), what is the cost effectiveness of comprehensive obesity management programs?						Lower Quality Rating if:
Modality: Lifestyle Intervention; **Outcome:** Cost-Effectiveness						☒ Studies inconsistent (*wide variation of treatment effect across studies, populations, interventions, or outcomes varied)* ☐ Studies are indirect *(PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)* ☒ Studies are imprecise (*When studies include few patients and few events and thus have wide confidence intervals and*
Author/Date	*Purpose of Study*	*Study Design & Methods*	*Sample*	*Outcomes*	*Design Limitations*	
Total # of Studies: 1 # of RCTs: 1						
Wolf, A.M., et al., *Journal of the American Dietetic Association,* 2007	To evaluate the program and health care costs of a lifestyle intervention in a high-risk obese population	RCT; Twelve-month randomized controlled trial comparing lifestyle case management to usual care. Lifestyle case management entailed individual and group education, support, and referrals by registered dietitians. Those in the usual-care group received educational material. Total costs were modeled using the four-equation model using previous year cost as a predictor.	147 members	**Net cost of the intervention was $328 per person per year. After incorporating program costs, mean health plan costs were $3,586 (95% confidence interval [CI]: -$8,036, -$25, P<0.05) lower in case management compared to usual care.** The difference was driven by group differences in medical (-$3,316, 95% CI: -$7,829 to -$320, P<0.05) but not pharmaceutical costs (-$239, 95% CI: -$870 to $280, not statistically significant), with fewer inpatient admissions and costs among case management compared with usual care (admission prevalence: 2.8% vs 22.5% respectively, P<0.001).	Study Limitations = ☒ None ***Economic Evaluation*** ☐ The research question is not clearly stated ☐ The perspective of interest is not clear (ie., societal, patient, health system, payer) ☐ The source(s) of effectiveness estimates are not clearly stated ☐ The primary outcome measures are not clearly stated ☐ The methods for the estimation of quantities and unit costs are not described	

						*the results are uncertain)* ☐ Publication Bias *(e.g. pharmaceutical company sponsors study on effectiveness of drug, only small, positive studies found)* <u>Increase Quality Rating if:</u> ☐ Large Effect ☐ Dose-response gradient ☐ Plausible confounders or other biases increase certainty of effect Quality (certainty) of evidence for studies as a whole: ☐ High ☐ Moderate ☒ Low ☐ Very Low

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