Cost-Effectiveness of Surgically Induced Weight Loss for the Management of Type 2 Diabetes: Modeled Lifetime Analysis

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OBJECTIVE — To estimate the cost-effectiveness of surgically induced weight loss relative to conventional therapy for the management of recently diagnosed type 2 diabetes in class I/II obese patients.

RESEARCH DESIGN AND METHODS — This study builds on a within-trial cost-efficacy analysis. The analysis compares the lifetime costs and quality-adjusted life-years (QALYs) between the two intervention groups. Intervention costs were extrapolated based on observed resource utilization during the trial. The proportion of patients in each intervention group with remission of diabetes at 2 years was the same as that observed in the trial. Health care costs for patients with type 2 diabetes and outcome variables required to derive estimates of QALYs were sourced from published literature. A health care system perspective was adopted. Costs and outcomes were discounted annually at 3%. Costs are presented in 2006 Australian dollars (AUD) (currency exchange: 1 AUD = 0.74 USD).

RESULTS — The mean number of years in diabetes remission over a lifetime was 11.4 for surgical therapy patients and 2.1 for conventional therapy patients. Over the remainder of their lifetime, surgical and conventional therapy patients lived 15.7 and 14.5 discounted QALYs, respectively. The mean discounted lifetime costs were 98,900 AUD per surgical therapy patient and 101,400 AUD per conventional therapy patient. Relative to conventional therapy, surgically induced weight loss was associated with a mean health care saving of 2,400 AUD and 1.2 additional QALYs per patient.

CONCLUSIONS — Surgically induced weight loss is a dominant intervention (it both saves health care costs and generates health benefits) for managing recently diagnosed type 2 diabetes in class I/II obese patients in Australia.

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Previous studies have concluded that surgically induced weight loss is a cost-effective intervention for managing severe obesity (1,2). However, no published studies have assessed the cost-effectiveness of surgically induced weight loss as an intervention for managing type 2 diabetes in obese patients.

A recent randomized controlled trial (RCT) confirmed observational evidence (3–5) that surgically induced weight loss leads to the remission of type 2 diabetes in the majority of obese patients. The 2-year RCT, which compared diabetes-related outcomes in 60 obese (mean BMI 37 kg/m²) adults with recently diagnosed (<2 years) type 2 diabetes randomized to either surgical therapy (laparoscopic adjustable gastric banding [LAGB]) or conventional therapy, has previously been reported (6).

RESEARCH DESIGN AND METHODS — An incremental cost-effectiveness analysis was undertaken, where the net costs and effectiveness of surgical therapy compared with conventional therapy were calculated and expressed as an incremental cost-effectiveness ratio (ICER). Costs include the lifetime cost of the interventions and the health care costs to treat type 2 diabetes. Effectiveness results are expressed as the number of quality-adjusted life-years (QALYs) gained. Analysis was undertaken from a health care system perspective. The use of health care resources by government, private insurers, and patients is included in the cost analysis. Outcomes are primarily acquired by patients (rather than government and private insurers); therefore, QALYs are used as the unit of measure on the benefits side of the analys.
Cost-effectiveness of surgically induced weight loss

Figure 1—Markov model: health states and first cycle annual transition probabilities.

ysis. Discounted (3% per annum) costs and QALYs were estimated. Costs are reported in 2006 Australian dollars (AUD). Costs sourced from alternative years are presented in 2006 values by applying the relevant price deflators (8). The midyear 2006 currency exchange rate, according to the XE currency Web site (9) was 1 AUD to 0.74 USD.

Modeling

Model structure. A Markov model that is representative of the natural history of type 2 diabetes for patients managed by either surgical therapy or conventional was constructed using TreeAge Pro Suite 2008 with links to Excel. Three health states were defined: type 2 diabetes remission, type 2 diabetes, and death. Health state transitions were limited to maintenance of the current health state or deterioration (Fig. 1). The model cycle length was 1 year, and half-cycle corrections were applied. Modeling was applied from the end of the 2-year RCT, with surgical and conventional therapy groups entering the model with their end-of-RCT mean age, mean BMI, diabetes status, and accumulated RCT intervention costs (see Table 2). The model was run until patients died or reached 99 years of age. Results of the model were generated using Monte Carlo simulation. Mean results are based on 20,000 random walks of the model.

Lifetime intervention pathways. The conventional therapy intervention was assumed to be implemented for the 2-year trial period. The surgical therapy intervention was assumed to be a lifetime program to monitor and maintain weight loss and the LAGB. Patients exiting the trial in type 2 diabetes remission (regardless of assigned intervention) were assumed to be monitored for maintenance of remission.

Variables within the model

Trial intervention effect. The trial intervention effect (type 2 diabetes status at end of trial) was applied as the relative risk of remission for surgical relative to conventional therapy patients. Uncertainty around the intervention effect was captured by assuming a normal probability distribution around the log of the relative risk reported for the RCT (6). Univariate probabilistic uncertainty analysis was undertaken to examine the effect of uncertainty around the relative risk using a Monte Carlo simulation. Simulation for 1,000 cohorts, each involving 20,000 iterations, was used to estimate the 95% uncertainty interval (UI) around the mean ICER and probabilities of acceptable cost-effectiveness. All patients were assumed to have a mean duration of type 2 diabetes of 3 years at the end of the trial. Therefore, benefits associated with diabetes remission accumulated after the trial period only.

Intervention costs. Surgical therapy maintenance costs were applied each year that surgical patients remained alive. The frequency of outpatient medical consultations and investigations was estimated by surgical experts at the Centre for Obesity Research and Education, Monash University, who have maintained a database of 4,500 LAGB patients over 14 years.

Surgical therapy complication costs were applied each year that surgical patients remained alive. Lifetime complication rates were estimated based on published data (10) and consultation with the authors to extrapolate results over the lifetime. The cumulative probability of a complication was estimated to be 17% every 10 years. To derive annual costs, it was assumed that complication rates were independent and constant over time. Resource use for surgical procedures to mitigate complications was estimated by trial surgeons based on the LAGB surgery for trial patients (7) (with adaptations to operating time, length of admission, and prosthesis requirements [details available on request]). Surgical costs were sourced from a private hospital and private medical specialists to reflect private provision as is commonly practiced in Australia. LAGB prostheses were valued based on commercial prices.

Diabetes remission—monitoring costs were applied each year that patients were in the type 2 diabetes remission health state. Medication and outpatient consultation resource use was extrapolated from the surgical intervention group during the last 6 months of the trial. Medical investigations and pathology requirements were estimated by a physician with expertise in diabetes management. Unless otherwise specified, unit costs for all resources were obtained from the Australian 2006 Medicare Benefits Schedule (11) and Pharmaceutical Benefits Schedule (12).

Treatment costs. Mean annual health care costs for patients with type 2 diabetes were sourced from the DiabCo$t study (13), which collected self-reported medication (antidiabetes, insulin, hypoglycemic, lipid lowering, and blood pressure...
Annual mortality probabilities were applied each year that patients were alive and were assigned based on type 2 diabetes status and age. Because of an absence of evidence regarding mortality risks for patients in remission from type 2 diabetes, this risk was assumed to be the same as that for patients without diabetes. Age-specific annual mortality probabilities for patients with and without diabetes were sourced from a 2008 study by Magliano et al. (16), which combined data from a national Australian cohort study (AusDiab) with national Australian mortality data. All model inputs and sources are summarized in Tables 1 and 2.

**Uncertainty analysis**

The impact of model variable uncertainty on the ICER was tested. Values tested reflected worst-case scenarios (i.e., decreasing cost-effectiveness of surgical therapy) and are described in Tables 1 and 2. The impact of combinations of variables likely to be related were tested, including: 1) combining all intervention costs in worst-case scenarios and 2) combining intervention effect and duration of diabetes remission in worst-case scenarios. Uncertainty in modeling assumptions was also tested, including 1) adding an additional LAGB surgical event to the lifetime intervention cost for each surgical patient (i.e., reflecting a routine LAGB replacement), 2) applying fixed health care treatment costs and utilities associated with type 2 diabetes (i.e., excluding the effects of disease duration and age), 3) applying type 2 diabetes mortality probabilities to all patients (i.e., assuming that the mortality probability of the population free of diabetes is not transferable to patients in type 2 diabetes remission), and 4) introducing a 0.03% probability of postoperative mortality for LAGB patients (i.e., superseding the actual zero mortality found in a trial with a probability reported by a systematic review [17]). Threshold analysis was undertaken to identify the minimum duration of diabetes remission required to deem surgical therapy cost-effective, assuming a willingness to pay threshold of 50,000 AUD per QALY (18).

**RESULTS** — Based on the assumptions and model parameters described, and relative to conventional therapy patients, surgical therapy patients gained a mean 9.4 additional years in diabetes remission, 1.6 additional life-years (undiscounted), and 1.2 discounted QALYs.

Mean discounted costs per patient were as follows: 98,900 AUD for surgical therapy and 101,400 AUD for conventional therapy. The health care cost to treat type 2 diabetes was the overwhelming cost driver and cost differential between the two intervention groups.

Relative to conventional therapy, surgically induced weight loss was a dominant alternative (associated with health care savings and health benefits) for managing type 2 diabetes in obese patients. On average, surgical therapy was associated with health care savings of 2,400 AUD and an additional 1.2 discounted QALYs per patient (95% CI dominant to 48,400 per QALY for ICER). The probability of surgical therapy being dominant and cost-effective was 57% and 98%, respectively. Results are summarized in Table 3.

Uncertainty in model values and assumptions either maintained the dominant status of surgical therapy or shifted it into a very cost-effective status (< 7,000 AUD per QALY), with the following exceptions. Worst-case scenarios for the intervention effect and the annual cost of treating type 2 diabetes shifted the economic status of surgical therapy from dominant to cost-effective (39,700 AUD and 13,400 AUD per QALY, respectively). Combining the intervention effect and duration of diabetes remission in worst-case scenarios also shifted the economic status of surgical therapy to cost-effective (48,200 AUD per QALY).

Detailed uncertainty results are listed in an online appendix (available at http://care.diabetesjournals.org/cgi/content/full/dc08-1749/DC1). Threshold analysis indicated that surgical therapy is cost-effective when the mean duration of remission from type 2 diabetes is at least 2 years and dominant when the mean duration of remission is at least 10 years.

**CONCLUSIONS** — Discounted results from this analysis suggest that both health gains and health care cost savings are likely realized by substituting conventional therapy with surgical therapy for obese patients presenting with recently diagnosed type 2 diabetes. Strictly from a cost perspective (disregarding quality of life and life expectancy benefits of diabetes remission), this analysis suggests that after 10 years the return on investment of surgical therapy is fully recovered through savings in health care costs to...
| Measurement | Valuation | Uncertainty analysis |
|-------------|-----------|---------------------|
|             | Annual units/probability | Source | Unit cost (AUD) | Annual cost (AUD) | Source | Annual cost (AUD) | Source |
| Surgical therapy maintenance (surgical patients) | | | | | | |
| Outpatient medical consultations | CORE case series data and expert opinion* | 32 | 64 | MBS 2006 (ref. 11) |
| Surgeon/physician/general practitioner | | | | | | |
| Surgeon/physician/general practitioner plus lap band adjustment | | | | | | |
| Medical investigations | CORE case series data and expert opinion* | 119 | 237 | MBS 2006 (ref. 11) |
| Barium meal (tests) | CORE case series data and expert opinion* | 90 | 27 | MBS 2006 (ref. 11) |
| Gastroscopy (investigations) | CORE case series data and expert opinion* | 157 | 31 | MBS 2006 (ref. 11) |
| Subtotal | | 360 | | | 720 | Expert opinion: increase by 100% |
| Surgical therapy complications (events) | | | | | | |
| Gastric prolapse | O'Brien 2002 (ref. 10) and extrapolation | 5,758† | 57 | Private hospital |
| Erosion of the band into the stomach | O'Brien 2002 (ref. 10) and extrapolation | 14,691† | 15 | Private hospital |
| Port infection | O'Brien 2002 (ref. 10) and extrapolation | 2,695† | 5 | Private hospital |
| Band removal | O'Brien 2002 (ref. 10) and extrapolation | 5,134† | 21 | Private hospital |
| Subtotal | | 98 | | | 196 | Expert opinion: increase by 100% |
| Type 2 diabetes remission monitoring | | | | | | |
| Outpatient medical consultations | Extrapolated from RCT (ref. 7) | 32 | 3 | MBS 2006 (ref. 11) |
| General physician | | | | | | |
| Endocrinologist | Extrapolated from RCT (ref. 7) | 38 | 53 | MBS 2006 (ref. 11) |
| Dietitian | Extrapolated from RCT (ref. 7) | 40 | 4 | MBS 2006 (ref. 11) |
| Pathology | CORE case series data and expert opinion* | 20 | 20 | MBS 2006 (ref. 11) |
| Routine pathology | CORE case series data and expert opinion* | 76 | 38 | MBS 2006 (ref. 11) |
| Outpatient medical investigations | CORE case series data and expert opinion* | 76 | 38 | MBS 2006 (ref. 11) |
| Ophthalmic assessment (tests) | CORE case series data and expert opinion* | 76 | 38 | MBS 2006 (ref. 11) |
treat type 2 diabetes in the surgical group. These results underestimate the potential benefits of surgical therapy. First, this analysis captures only one benefit: the remission of type 2 diabetes. The surgical intervention also facilitated significant and sustained weight loss (mean BMI from 37 to 29 kg/m²). The analysis did not seek to capture non–diabetes-related health care cost savings associated with a reduction in obesity-related morbidity (19), improvements in quality of life attributable to weight loss (19), or survival benefits of weight loss after bariatric surgery (19,21).

Second, the analysis did not endeavor to capture the substantial benefits from glycemic control demonstrated by surgical patients who did not achieve type 2 diabetes remission.

Third, we did not apply a differential duration of diabetes remission to conventional therapy patients, despite evidence that nonsurgical interventions fail to demonstrate maintenance of weight loss over time (22), which may correlate with faster diabetes relapse. Finally, no benefits were applied to the trial period.

Comparison with the literature

Previous studies have found surgically induced weight loss to be cost-effective for managing obesity (1,2). This study finds surgically induced weight loss for managing type 2 diabetes in the obese population to be superior from an economic perspective because it generates both cost savings and health benefits. The cost-saving result is consistent with findings from a 2008 U.S. study by Cremieux et al. (23), which found, based on a third-party payer perspective of actual patient costs, that the initial investment in bariatric surgery was offset by downstream health care savings after 4 years.

Resource assumptions employed by our study differ from previous economic evaluations of LAGB surgery. Efficiency gains in LAGB surgery techniques are captured by adopting significantly lower (actual RCT) mean operating and admission durations. Safety gains are captured by including zero operative mortality. We employed a more comprehensive approach to estimating complication rates, including all serious perioperative complications and extrapolating rates over the lifetime of patients. Optimal schedules for maintaining weight loss are captured through a rigorous approach. Annual units/probability Source Unit cost (AUD) Annual cost (AUD) Source Annual cost (AUD) Source

Prescription medication

| Measurement          | Unit cost (AUD) | Annual cost (AUD) | Source |
|----------------------|-----------------|-------------------|--------|
| Antihypertensives    | 86†             | 86                | PBS 2006 (ref. 12) |
| Diabetes             | 15†             | 15                | PBS 2006 (ref. 12) |
| Lipids               | 121§            | 121               | PBS 2006 (ref. 12) |
| Other                | 71§             | 71                | PBS 2006 (ref. 12) |
| Subtotal             | 411             |                   |        |

Health care costs for patients with type 2 diabetes (100% applied to patients with type 2 diabetes; 43% applied to patients in remission)

Annual cost 3,281–12,221§ (mean 5,018)

*Centre for Obesity Research and Evaluation (CORE) database and consultation with surgical experts (data unpublished). †Detailed unit-cost calculations available on request. ‡Refer to cost-effectiveness paper for costing methods, based on surgical therapy cohort cost for trial months 18–24. §Assigned based on duration of disease and patient age. Detailed data by duration of disease (5-year categories) and age (10-year categories) available on request. These data are being prepared for publication by DiabCoST.
### Table 2—Epidemiological, clinical, and RCT inputs for cost-effectiveness model (annual per patient)

| Variable                                                                 | Intervention group | Source                   | Uncertainty analysis |
|--------------------------------------------------------------------------|--------------------|--------------------------|----------------------|
|                                                                           | All                | Surgical                 | Conventional         | Source | Lower boundary of RCT | 95% CI (ref. 6) |
| Profile of each intervention group (commencement of model)               |                    |                          |                      |        |                      |                  |
| Demographic                                                              |                    |                          |                      |        |                      |                  |
| Sample size (patients)                                                   | 30                 | 30                       | RCT (ref. 6)         |        |                      |                  |
| Mean age (years)                                                         | 49                 | 49                       | RCT (ref. 6)         |        |                      |                  |
| Sex (female)                                                             | 17                 | 16                       | RCT (ref. 6)         |        |                      |                  |
| Diabetes status                                                          |                    |                          |                      |        |                      |                  |
| Relative risk of remission in surgical relative to conventional therapy  | Probability        | RCT (ref. 6)             | 2.2                  | 95% CI  |                      |                  |
| patients                                                                 | distribution (mean 5.5 [95% CI 2.2–14]) |                      |                      |        |                      |                  |
| Mean no. with type 2 diabetes remission (patients)                       | 4                  | RCT (ref. 6)             |                      |        |                      |                  |
| Mean duration of type 2 diabetes (years)                                 | 3                  | RCT (ref. 6)             |                      |        |                      |                  |
| Mean BMI (kg/m²)                                                         | 29                 | 37                       | RCT (ref. 6)         |        |                      |                  |
| 2-year RCT intervention cost (AUD)                                        | 13,383             | 3,396                    | Cost-efficacy analysis (ref. 7) |        |                      |                  |
| Utility weights reflecting quality of life associated with type 2 diabetes| 0.67–0.81* (mean 0.80) | DiabCo$t study (ref. 13) | 0.82                | Expert opinion: utility loss at 50% |        |                  |
| Type 2 diabetes                                                          | 0.84               | Hawthorne study (ref. 15) |                      |        |                      |                  |
| Type 2 diabetes remission                                               |                    |                          |                      |        |                      |                  |
| Transition probabilities                                                 | 0.052†             | Greeneville and SOS studies (ref. 3, 5) | 0.067† | SOS (ref. 5) |        |                  |
| Annual probability for relapse to type 2 diabetes                        | 0.008–0.328‡       | AusDiab study (ref. 16) |                      |        |                      |                  |
| Annual mortality probability: type 2 diabetes (Age 49–99 years)          | 0.002–0.332‡       | AusDiab study (ref. 16) |                      |        |                      |                  |

*Assigned based on duration of disease. Detailed data by duration of disease (5-year categories) available on request (unpublished data). being prepared for publication by DiabCo$t. †Equivalent to mean duration of remission of 13 years (0.052) and 10 years (0.067). ‡Detailed data by age available on request. AIHW, Australian Institute of Health and Welfare; MBS, Medicare Benefits Schedule; PBS, Pharmaceutical Benefits Schedule.
Discounted at 3% for both costs and benefits

| Costs (AUD)                       | Surgical | Conventional | Difference |
|----------------------------------|----------|--------------|------------|
| 2-year RCT intervention          | 13,383   | 3,397        | 9,987      |
| Surgical intervention maintenance| 6,477    | 6,477        | 0          |
| Surgical intervention complications| 1,768    | 1,768        | 0          |
| Type 2 diabetes remission—monitoring costs | 16,479   | 2,874        | 13,605     |
| Health care costs to treat type 2 diabetes | 60,824   | 95,105       | (34,281)   |
| Total cost                       | 98,931   | 101,376      | (2,444)    |

Effectiveness

| Effectiveness               | Surgical | Conventional | Difference |
|----------------------------|----------|--------------|------------|
| Total life-years            | 20.0     | 19.2         | 0.7        |
| QALYs                       | 15.7     | 14.5         | 1.2        |

Cost-effectiveness

| Cost per life-year gained     | Dominant | |
| Cost per QALY                 | Dominant | |
| Probability of dominance      | 57%      | |
| Probability of cost-effectiveness at willingness-to-pay threshold | 98% | |

Dominant: generates health care savings and health benefits. Willingness-to-pay threshold, 50,000 AUD per QALY.

Limitations

The transferability of diabetes remission duration results from the Greenville Series and SOS to this RCT is uncertain—the Greenville Series because research suggests that the surgical technique employed, gastric bypass surgery, contributes to diabetes remission through mechanisms independent of weight loss (24) and the SOS study because weight loss (the driver of type 2 diabetes remission through LAGB [6]) was poorly sustained, contrary to sustained weight loss anticipated for the LAGB trial population (25). Additionally, the duration of type 2 diabetes for patients in our RCT (all recently diagnosed) was likely substantially shorter than that of the Greenville and SOS studies, which may correlate with improved diabetes remission outcomes for our trial patients.

To simulate outcomes in the period after the trial, we made assumptions about the costs, diabetes relapse rate, and mortality rate for patients in remission from diabetes. While our assumptions were based on the best available data, the possibility that some were wrong was tested by extensive uncertainty analyses.

The generalizability of cost-effectiveness results to other populations may be limited due to different intervention effects, complication rates, or health care costs. Results are only directly transferable to the clinical population with class I and II obesity and recently diagnosed type 2 diabetes in Australia.

In conclusion, the RCT demonstrated the health benefits of substantial weight loss for the obese patient with recently diagnosed type 2 diabetes. The present study shows that this benefit can be achieved with associated cost savings. Substantial weight loss should be sought in all such patients, and if nonsurgical measures are unsuccessful, the option of LAGB should be discussed.

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References

1. Clegg A, Colquitt J, Sidhu M, Royle P, Walker A: Clinical and cost effectiveness of surgery for morbid obesity: a systematic review and economic evaluation. *Int J Obes Relat Metab Disord* 27:1167–1177, 2003

2. Salem L, Devlin A, Sullivan SD, Flum DR: Cost-effectiveness analysis of laparoscopic gastric bypass, adjustable gastric banding, and nonoperative weight loss interventions. *Surg Obes Relat Dis* 4:26–32, 2008

3. Pories WJ, Swanson MS, MacDonald KG, Long SB, Morris PG, Brown BM, Barakat HA, deRamon RA, Israel G, Dolezal JM, Dohn L: Who would have thought it? An operation proves to be the most effective therapy for adult-onset diabetes mellitus. *Ann Surg* 222:339–350, 1995; [discussion 222:350–352, 1995]

4. Dixon JB, O’Brien PE: Health outcomes of severely obese type 2 diabetic subjects 1 year after laparoscopic adjustable gastric banding. *Diabetes Care* 25:358–363, 2002

5. Sjostrom L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlson B, Dahlgren S, Larsson B, Narbro K, Sjostrom CD, Sullivan M, Wedel H: Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. *N Engl J Med* 351:2683–2693, 2004

6. Dixon JB, O’Brien PE, Playfair J, Chapman L, Schachter LM, Skinner S, Proietto J, Bailey M, Anderson M: Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. *JAMA* 299:316–323, 2008

7. Keating CL, Dixon JB, Moodie ML, Peeters A, Playfair J, O’Brien PE: Cost-effectiveness of surgically induced weight loss for the management of type 2 diabetes: a randomized controlled trial. *Diabetes Care* 32:580–584, 2009

8. Australian Institute of Health and Welfare: Health expenditure Australia 2005–06: health and welfare expenditure series no. 30
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[article online], 2007. Available from http://
www.aihw.gov.au/publications/index.cfm/ title/10529. Accessed 9 February 2008
9. XE.com quick cross rates [Internet], 2008. Available from http://www.xe.com. Accessed 10 June 2008
10. O’Brien PE, Dixon JB: Weight loss and early and late complications: the international experience. Am J Surg 184:42S–45S, 2002
11. Australian Government Department of Health and Ageing: Medicare Benefits Schedule: allied health and dental services [article online], 2006. Available from http://www.health.gov.au/internet/mbsonline/publishing.nsf/Content/Medicare-Benefits-Schedule-MBS-Downloads-Nov08. Accessed 20 March 2008
12. Australian Government Department of Health and Ageing: Schedule of pharmaceutical benefits for approved pharmacists and medical practitioners [article online], 2006. Available from http://www.pbs.gov.au/html/healthpro/publication/view?date=H1100520060801&type=FlashPaper&name=general-schedule. Accessed 1 April 2008
13. Colagiuri S, Colagiuri R, Conway B, Gratinger D, Davey P: DiabCo$t Australia: assessing the burden of type 2 diabetes in Australia [article online], 2003. Available from http://www.diabetes.nsw.com.au/PDFs/About_Diabetes_PDFs/diabcost_finalreport.pdf. Accessed 15 February 2008
14. American Diabetes Association: Economic costs of diabetes in the U.S in 2007 (Position Statement). Diabetes Care 31:1–20, 2008
15. Hawthorne G, Richardson J, Day NA: A comparison of the Assessment of Quality of Life (AQoL) with four other generic utility instruments. Ann Med 33:358–370, 2001
16. Magliano DJ, Shaw JE, Shortreed SM, Nusselder WJ, Liew D, Barr EL, Zimmet PZ, Peeters A: Lifetime risk and projected population prevalence of diabetes. Diabetologia 51:2179–2186, 2008
17. Maggard MA, Shugarman LR, Suttorp M, Maglione M, Sugarman HJ, Livingston EH, Nguyen NT, Li Z, Mojica WA, Hilton L, Rhodes S, Morton SC, Sherkelle PG: Meta-analysis: surgical treatment of obesity. Ann Intern Med 142:547–559, 2005
18. George B, Harris A, Mitchell A: Cost effectiveness analysis and the consistency of decision making: evidence from pharmaceutical reimbursement in Australia 1991-96 [article online], 1999. Available from http://www.buseco.monash.edu.au/centres/che/pubs/wp89.pdf. Accessed 15 March 2008
19. Christou NV, Sampalis JS, Liberman M, Look D, Auger S, McLean AP, MacLean LD. Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients. Ann Surg 240:416–423, 2004; [discussion 240:423–424, 2004]
20. Karlsson J, Tafj C, Ryden A, Sjostrom L, Sullivan M: Ten-year trends in health-related quality of life after surgical and conventional treatment for severe obesity: the SOS intervention study. Int J Obes (Lond) 31:1248–1261, 2007
21. Adams TD, Gress RE, Smith SC, Halversen RC, Simper SC, Rosamond WD, Lamonte MJ, Stroup AM, Hunt SC: Long-term mortality after gastric bypass surgery. N Engl J Med 357:753–761, 2007
22. Norris SL, Zhang X, Avenell A, Gregg E, Bowman B, Serdula M, Brown TJ, Schmid CH, Lau J: Long-term effectiveness of lifestyle and behavioral weight loss interventions in adults with type 2 diabetes: a meta-analysis. Am J Med 117:762–774, 2004
23. Cremieux PY, Buchwald H, Shikora SA, Ghosh A, Yang HE, Buesing M: A study on the economic impact of bariatric surgery. Am J Manag Care 14:589–596, 2008
24. Vincent RP, le Roux CW: Changes in gut hormones after bariatric surgery. Clin Endocrinol (Oxf) 69:173–179, 2008
25. O’Brien PE, McPhail T, Chaston TB, Dixon JB: Systematic review of medium-term weight loss after bariatric operations. Obes Surg 16:1032–1040, 2006 Australian Institute of Health and Welfare: Health expenditure Australia 2005-06: health and welfare expenditure series no. 30 [article online], 2007.
26. Mathers C, Penn R. Health system costs of cardiovascular diseases and diabetes in Australia 1993–94: health and welfare expenditure series no. 5 [article online], 1999. Available from http://www.aihw.gov.au/publications/index.cfm/title/4060. Accessed 15 July 2008