The United Kingdom National Bariatric Surgery Registry

Second Registry Report
2014

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Foreword

Obesity and bariatric surgery are rapidly rising up the NHS agenda as a consequence of social and lifestyle choices. As in all branches of medicine, prevention is better than cure, but this report clearly demonstrates that when required, bariatric surgery is effective and safe. This is based on detailed data on over 18,000 patients. The survival rate of over 99.9% and the decreasing length of time spent in hospital is all the more impressive given the increasing illness of patients being sent for surgery.

Perhaps most importantly this second report demonstrates the commitment of British surgeons to share their data in the interests of understanding and improving the quality of care they offer. It describes the state of the art in 2014. The pooling of so much data will help define the place of surgery for people debilitated by obesity and will, in time, help to refine surgical strategies and even unravel the mystery of why this surgery has such an instantaneous, profound and beneficial effect on diabetes, another scourge of our society.

In short, this report is a tribute to the professionalism of the British Obesity & Metabolic Surgery Society.

Prof. Sir Bruce Keogh

Medical Director of the National Health Service in England
Reflections from Down Under

This second report of the National Bariatric Surgery Registry (NBSR) analyses the cohort of bariatric surgery patients having procedures during the financial years 2011-2013 inclusive, and examines 16,956 primary and 1,327 revisions or planned second stage procedures. The report provides very detailed insights into changing patterns among those having bariatric operations and the procedures that they are undergoing, and the overall early outcomes achieved. This commentary will focus on the changing characteristics of those choosing to seek a surgical procedure, which of course is influenced by selection criteria that may vary regionally and with public versus private payment.

An important trend since the inception of the United Kingdom registry in 2009 has been the increasing proportion of men seeking surgery. In 2006, 16% of those having primary procedures were men, while in 2013 the proportion had risen to almost 26%. It is important to recognise that while men in the United Kingdom are more likely to be overweight or obese, and the rates of obesity (BMI >30 kg m\(^{-2}\)) for men and women are similar; women dominate the class III obese category by around 2:1 (1.5% for men and 3.0% for women)\(^1\). Men who have surgery tend to be a little older and have, on average, a higher BMI than women, and they make up just 10% and 24% of those having surgery in the class I and Class II ranges respectively. Therefore, the increase in the proportion of patients who are men, from 16% to 26%, represents a major step towards gender equity in those electing to have surgery, especially for men with Class III obesity.

Comorbidities

The average number of reported obesity-related comorbidities increases with age and also for those with a greater BMI before surgery. There are clear gender differences in obesity-related comorbidity reported prior to surgery. Women are more likely than men to report depression, asthma and gastro-oesophageal reflux; while men report higher rates of hypertension, obstructive sleep apnoea, type-2 diabetes, dyslipidaemia, atherosclerosis, and liver disease. Men and women report similar rates of poor functional status and arthritis. There has been a steady increase in the average numbers of obesity-related comorbidities reported between 2006 and 2013 for both men (2.6 to 3.7) and women (2.3 to 3.4). These increases have been reported across the whole BMI range, especially in those with a BMI below 40.

The relationship between reported comorbidity rates and BMI is of interest, as for some conditions there is a clear positive linear relationship, while for others there is not. Poor functional status, arthritis, asthma, sleep apnoea, and depression in women all have a clear pattern of increased prevalence in reporting with increased BMI, but gastro-oesophageal reflux, hypertension, dyslipidaemia, type-2 diabetes and atherosclerosis do not demonstrate such clear relationships. These non-linear associations are important and have been noted previously. Increased BMI imparts major restrictions on quality-of-life and function, but not necessarily on classical cardio-metabolic risk factors.

The Edmonton Obesity Staging System (EOSS) has been used to better assess and stage obesity-related comorbidity. In brief, it assesses mechanical, metabolic and psychological aspects of obesity, and separates patients into five risk groups: no clear risks (stage 0), pre-clinical (stage 1), established risks or disease (stage 2), end-organ damage (stage 3), and end-stage disease (stage 4). The majority of all patients operated were classified as stage 2 before surgery. However, the proportion of patients classified in stages 3 or 4 has increased substantially between 2006 and 2013; the proportion of women who fell in to stages 3 or 4 patients has risen from 7% to 26%, and for stage 4 alone from 1% to greater than 16%; the proportion of men classified as either stage 3 or stage 4 rose from 10% to 37% over the same period, and men in the stage 4 category alone rose from 5% to more than 20%. These changes reflect a clear trend to treating those patients with greater risk of mortality associated with their obesity\(^2,3\). At the same time as operating on patient populations with ever-increasing rates of comorbidity and more severe disease, average hospital stay has stayed reduced: an extraordinary achievement.

Type 2 diabetes

During the triennium 4,121 primary procedures were performed on patients with type 2 diabetes and 742 with impaired fasting glucose or glucose tolerance. Type 2 diabetes was reported in 25% of women and 45% of men before surgery. Remission of diabetes, which was based on report rather than strict biochemical criteria, was noted more frequently as the first 3 years following surgery progressed: at 3 years 80% in total were classified as being in clinical remission. Reported remission was strongly related to weight loss at every time point. BMI as a predictor of remission was not evident, supporting the important observation that it is not attained BMI that is important, but the weight loss (excess weight loss) state itself that drives much of the improvement. The registry data support the observations that a longer duration of diabetes and type 2 diabetes requiring insulin therapy,
Introduction

Two factors that are clearly related, reduce the likelihood of glycaemic improvement. Clearly bariatric-metabolic surgery has become an acceptable option for the management of type 2 diabetes in those with clinically severe obesity and the results in terms weight loss and glycaemic control are impressive.

Clinically severe obesity

The management of clinically severe obesity involves chronic disease management. Joining up clinical pathways throughout the tiers of health care delivery is therefore logical for obesity just as it is for other chronic disease 4. For bariatric surgery patients, a continuum of care and integration from primary care through to the specialised provision of bariatric surgery is an essential element in the chronic disease management process. Surgery provides a brief, but important, interval of attention within the context of long-term care, in a similar way that cardiac, vascular, endocrine, oncology, gastrointestinal and orthopaedic surgery must integrate at many levels in delivering optimum health outcomes for chronic disease management. Recognition that joining up obesity clinical pathways and delivery of Tier 3 obesity assessment and management services has been a fundamental step in providing better care for those with clinically severe obesity 4,5.

Finally, how do we prioritise surgical therapy to those most in need and most likely to benefit? The answer is not clear and requires a broad health care provider perspective. There is an important distinction between being eligible for surgery or prioritised for surgery. Prioritisation implies that, given the patient’s current health status, bariatric-metabolic surgery should be recommended, by a caring physician, as best care. This concept is an accepted responsibility of health care providers, but for those with clinically severe obesity barriers dominate rights. How can the registries locally and globally assist in addressing this important health delivery gap?

Summary

1. The increased proportion of men, higher rates of obesity related comorbidity, and higher EOSS scores reported in the last triennium indicate a change in the selection of patients. This may be due to a maturation in our understanding of the surgical risks to benefits and an acceptance of the health benefits of substantial, sustained weight loss.

2. The high proportion of patients with diabetes among those seeking surgery indicates that the message regarding bariatric-metabolic surgery and type 2 diabetes is being heard.

3. The more formal streamlining of clinical pathways and expansion of Tier 3 obesity assessment and management services will add an important layer to improving patient care and outcomes. This provides an opportunity and a challenge for the registry to incorporate outcome measures relevant to the continuum of care.

4. How do we prioritise surgical therapy to those most in need and most likely to benefit?

Prof. John Dixon

NHMRC Senior Research Fellow,
Adjunct Professor, Primary Care Research Unit, Monash University
Head of Clinical Obesity Research, Baker IDI Heart and Diabetes Institute
Head of Weight Assessment & Management Clinic, Baker IDI Heart and Diabetes Institute

References


A patient’s perspective

It was a rare and welcome honour to be approached by the Committee responsible for this excellent report to contribute to its introduction. Weight Loss Surgery Information and Support (WLSinfo) is a large, patient-led charity established in 2003, of which I am proud to be the Chair. I have been both blessed and fortunate to see an increase in the number of Bariatric Surgery operations nationally, and steady improvements in its quality over the years. Our inclusion as stakeholders here reflects for me the importance that BOMSS places on the partnership with patients. The first NBSR report gave a comprehensive set of baseline data, which has been added to and improved in this second edition. As a patient, I am reassured by the findings regarding mortality, complications and length-of-stay.

Patients are often inquisitive as to a surgeon’s experience in a particular procedure, and this report goes a long way towards reassuring patients about their chosen surgeon.

The surgeons who have contributed to the NBSR have measured their collective activity and this will be expanded in coming years to allow a continuous quality improvement process, and will surely contribute favourably to the debate around the clinical-effectiveness and cost-effectiveness of bariatric surgery.

The NHS faces opportunities and challenges in areas including Commissioning NHS services and proposed changes to NICE guidelines. This makes the need for good-quality, robust data even more important.

I congratulate the Database Committee, the Society and all who have contributed to this excellent report.

I recommend all patients considering surgery to look at the information it contains regarding their surgeon and to discuss it with them.

Ken Clare
Chair of Trustees Weight Loss Surgery Information and Support (WLSinfo)
Executive summary

This is the second comprehensive, nationwide analysis of outcomes from bariatric (obesity) and metabolic surgery in the United Kingdom & Ireland:

In overview:

- 161 surgeons from 137 hospitals recorded 32,073 operations; 18,283 in the three financial years ending 2011, 2012 and 2013.
- In 2011-2013 76.2% operations were funded by the National Health Service; 22.6% were independently funded and a tiny proportion were paid for by private insurers.
- The majority of the analyses include data on operations carried out in the financial years 2011-2013, and include information on 9,526 gastric bypass procedures, 4,705 gastric band operations and 3,797 sleeve gastrectomy operations.
- 95.4% of all primary operations were performed laparoscopically over the last three financial years 2011, 2012 and 2013.
- The observed in-hospital mortality rate after primary surgery was 0.07% overall (and just 0.07% for gastric bypass), much lower than that for many other planned operations.
- The recorded surgical complication rate overall for primary operations was 2.9%.
- These figures compare to the best internationally available outcome benchmarks. Thus, surgery in the United Kingdom & Ireland, in the hands of the contributors, is safe.
- The average post-operative stay was 2.7 days, indicating efficient use of resources.

At the time of primary surgery:

- The average BMI was 48.8 kg m\(^{-2}\), which means that patients were almost twice their ideal weight.
- 53.9% of men and 41.4% of women had a high level of co-existing disease (4 or more obesity-related diseases).
- 44.6% of men and 25.9% of women had type 2 diabetes.
- 39.9% of men and 15.8% of women were on treatment for sleep apnoea.
- 73.2% of men and 71.5% of women had some functional impairment, i.e., they could not manage to climb 3 flights of stairs without resting.
- Comparing the financial years 2009-2010 to 2011-2013, the average BMI has increased from 48.5 kg m\(^{-2}\) to 48.8 kg m\(^{-2}\); the average number of comorbidities has increased from 3.2 to 3.4; the average Obesity Surgery Mortality Risk Score (OSMRS) has increased from 1.6 to 1.8; and average post-operative stay has fallen from 3.1 days to 2.7 days, even more remarkable given that the proportion of operations that were gastric banding (typically a 24-hour stay operation) has decreased and the proportion of operations that were sleeve gastrectomy procedures (where patients stay 2-3 days typically) has increased.
Follow-up data derived from some 30,933 follow-up entries for the 2011-2012 patients show:

one year after primary surgery:

- On average, patients lost 58.4% of their excess weight (36.6% for gastric banding, 68.7% for gastric bypass & 58.9% for sleeve gastrectomy).
- Over half of patients (64.0%) with pre-operative functional impairment returned to a state of no impairment one year after surgery, meaning they could climb 3 flights of stairs without resting.
- 61.0% of patients with sleep apnoea were able to come off treatment.

two years after primary surgery:

- 65.1% of patients with type 2 diabetes returned to a state of no indication of diabetes, meaning, in practice, that they were able to stop their diabetic medications.

three years after primary surgery for the 2006-2011 cohort:

- On average, patients lost 59.6% of their excess weight (52.9% for gastric banding, n=453; 65.4% for gastric bypass, n=536; & 59.0% for sleeve gastrectomy, n=40).

Comment on mortality data:

- Two external sources have assessed mortality using independently-collected Hospital Episodes Statistics (HES) data:
  - In an analysis conducted by the Quality Outcomes Research Unit in Birmingham presented on page 42 as part of the Surgeon-Level Outcomes Publication (2013) the estimated mortality for primary bariatric surgery for the 4 years April 2009 to February 2013 was 0.11% (25 / 23,760).
  - In an earlier HES analysis of patients having bariatric surgery between 2000 and 2008, the 30-day mortality rate was 0.27% (19 / 6,953). When laparoscopic cases alone were considered, the mortality was much lower at 0.16% (7 / 4,436).

- Taking the evidence together, the NBSR Committee believes our results in the Second Report to be an accurate representation of the outcomes of those surgeons who submitted their data. We do not have 100% data submission yet, but this will come.

Healthcare implications:

- Severe & Complex Obesity is a serious, life-long condition associated with many major medical conditions, the cost of which threatens to bankrupt the NHS. For severely obese people, medical therapy, lifestyle changes and attempts at dieting rarely succeed in maintaining long-term, clinically beneficial weight loss due to the hormonal effects of the obese state, dieting, and energy balance and metabolic rate.
- For all comparisons, the data show that there is great benefit from bariatric surgery for all the diseases studied, in particular the effect on diabetes has important implications for the NHS.
- By implication, bariatric surgery greatly and cost-effectively improves the health of obese patients, much more so than other treatments.

From the Chairman of the Database Committee and President of BOMSS

It is an honour and a privilege to present this Second Report of the National Bariatric Surgery Registry. Since the inaugural report in 2011 on data from over 8,000 operations, bariatric surgery in the United Kingdom has become more formalised, with NHS England publishing the Clinical Commissioning Policy for Complex and Specialised Obesity Surgery in April 2013. The Royal College of Physicians has also issued a call to action to ramp up medical obesity services and awareness of treating overweight and obese patients. Despite all this, the rate of surgery in the United Kingdom has fallen significantly, and this poses many challenges for clinicians trying to offer clinically- and cost-effective care for their patients. It is therefore timely to present data on a further 18,000 patients operated upon in the United Kingdom between 2010 and 2013, demonstrating some remarkable improvements in obesity-related disease after surgery, with up to 3 years of follow up data recorded.

When bariatric surgery for severe and complex obesity was first undertaken over 50 years ago, all surgery was undertaken using open surgical techniques. The scene has now changed dramatically, with nearly all surgery performed by laparoscopic (keyhole) techniques, which, together with protocols for enhanced recovery, mean that pain is much reduced for the patient and hospital stay is much shorter than before. The data presented in this report cover 3 main operations: gastric bypass, gastric banding and sleeve gastrectomy. We do not know which is the best bariatric surgery operation. Surgical techniques and trends change over time and with experience, but collecting a large amount of data on many thousands of patients means that important observations can be made that, in turn, lead onto and form the basis for research questions.

We urge those new to the field to look at the sections on diabetes control: the NHS is saving money because patients are coming off their diabetes medication (pages 143-147 and 152-155) as a direct result of their bariatric surgery. Patients are also seeing vast improvement in their functional status, where even wheelchair users or housebound patients recover the ability to climb stairs (pages 143-151). These findings clearly show the efficacy of bariatric surgery for patients.

It is important to note that the NBSR was formed as a collaboration between three specialist surgical societies: the Association of Laparoscopic Surgeons, the Association of Upper Gastrointestinal Surgeons and the British Obesity and Metabolic Surgery Society (BOMSS), and their data management partner Dendrite Clinical Systems, and in large part to date has received no public funding. Bariatric surgery was one of the 10 specialties to participate in the publication of Surgeon-Level Consultant Outcomes in 2013 and anticipates receiving funding from the Healthcare Quality Improvement Partnership for the next round in October 2014. Aside from this, there has been no offer of public funding for the Registry whose day-to-day administration was taken over by BOMSS in January 2014. Publication of this report involved no public funding and the committee does not receive remuneration.

On a hospital level in the United Kingdom there is a distinct lack of administrative support to assist surgeons in assuring data quality; in particular there is no infrastructure to address the 3 problems of data quality, namely: missing records, incomplete records and erroneous data. There is also poorly-developed infrastructure, especially in capturing follow up beyond 2 years, in stark contrast to the processes deeply embedded within the NHS to collect data on, for example, cancer treatment and survival. This is a big challenge: how to improve the follow up of patients and record 5-year outcome data within the NHS. Even so, the complications and mortality data presented are comparable with the international literature, and there are many new findings that have not been observed before on the scale of a national registry on the outcomes following surgery for obesity-related disease.

This unique database provides clear evidence that bariatric surgery radically improves health for patients with severe and complex obesity. It demonstrates that the health benefits of bariatric surgery reported in the international literature apply equally to our patients in the United Kingdom.

The challenges of raising awareness of the effects of bariatric surgery and increasing service provision are considerable. Many factors including deeply held societal prejudice and reorganisations within the NHS appear to be limiting the provision of surgery, which is much less than in other equivalent countries. For our part, those surgeons who submitted their data to the Registry in England have been open and transparent with their operative results, and to facilitate the pathway of patients from their GP to surgery BOMSS has developed multi-collegiate commissioning guidance. The texts of both the 2013 Consultant Outcomes Publication and the 2014 Tier 3 Commissioning Guidance are reproduced in subsequent pages.

The NBSR Database Committee is grateful to all those surgeons who have voluntarily contributed their NHS and private patient data to the Registry in the time leading up to April 2013, when data submission became mandatory for units providing NHS surgery. There has been a substantial increase in the number of surgeons contributing since the first report from 84 to 150, and the number of contributing hospitals has increased from 86 to 129.
We are also immensely grateful to Dr Peter Walton and Dr Robin Kinsman of Dendrite who have enthusiastically, patiently and expertly put in many, many hours of time to project plan, analyse the data and help us deliver the report over the last 6 months.

We are also indebted to Professors John Dixon, Paul O’Brien, Alberic Fiennes and Michel Gagner for contributing invited commentaries for the sections on gastric banding, gastric bypass and sleeve gastrectomy respectively. The NBSR Database Committee and bariatric surgeons are immensely grateful to Jenny Treglohan, who took on the considerable burden of being NBSR Administrator for the Surgeon-Level Outcomes Publication in 2013, and Sarvit Wünsch and Nichola Coates who took over as NBSR administrators this year.

Richard Welbourn
President of the BOMSS and Chair of the NBSR Database Committee

1. Blazeby JM, Byrne J, Welbourn R. What is the most effective operation for adults with severe and complex obesity? *BMJ*. 2014; 348: g 1763
Submission of data to the NBSR has recently become a condition for NHS commissioning of bariatric surgery, so in future the NBSR should contain data on all NHS-funded bariatric surgery patients. Whilst submission of data for privately funded patients is not yet mandatory, it is anticipated that data for most of these patients will also be included. The data from the financial year ending 2014 were only around 50% complete as data were harvested in October 2013. The 2014 data have therefore been excluded from subsequent cohort analyses as they do not represent a full year of activity.
Funding

The current data from the NBSR show that the proportion of bariatric operations that were publicly funded was 72.1% in 2009-2010, rising significantly to 76.2% by 2011-2013 (p<0.001; $\chi^2$ 2x2 contingency table). This may be due to an increasing provision of surgery funded by the National Health Service, but may also be a reflection of the worsening economic climate over the latter period, with fewer patients being able to afford bariatric surgery privately. However, there have also been significantly fewer publicly funded operations. The reasons for this are not known but may reflect reluctance to fund an area of surgery that is well known to suffer from prejudice.

Whilst the proportions of both Roux-en-Y gastric bypass and gastric band operations that were publicly funded significantly increased over the two time-periods (2009-2010 versus 2011-2013), the proportion of sleeve gastrectomy operations that were publicly funded decreased significantly (p=0.039); however, the numbers here are small, and future NBSR reports will reveal whether this is a real and continuing trend.

Primary operations: type of operation and source of funding; financial years 2011-2013

<table>
<thead>
<tr>
<th>Operation</th>
<th>Publicly</th>
<th>Self-pay ¹</th>
<th>Private ²</th>
<th>Unspecified</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric band</td>
<td>1,879</td>
<td>1,666</td>
<td>20</td>
<td>68</td>
<td>3,633</td>
</tr>
<tr>
<td>Roux-en-Y gastric bypass</td>
<td>7,750</td>
<td>1,228</td>
<td>122</td>
<td>33</td>
<td>9,133</td>
</tr>
<tr>
<td>Sleeve gastrectomy</td>
<td>2,795</td>
<td>758</td>
<td>61</td>
<td>17</td>
<td>3,631</td>
</tr>
<tr>
<td>Duodenal switch &amp; sleeve</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Gastric balloon</td>
<td>198</td>
<td>95</td>
<td>1</td>
<td>0</td>
<td>294</td>
</tr>
<tr>
<td>Other</td>
<td>146</td>
<td>31</td>
<td>1</td>
<td>3</td>
<td>181</td>
</tr>
<tr>
<td>Unspecified</td>
<td>46</td>
<td>14</td>
<td>0</td>
<td>13</td>
<td>73</td>
</tr>
<tr>
<td>All</td>
<td>12,820</td>
<td>3,797</td>
<td>205</td>
<td>134</td>
<td>16,956</td>
</tr>
</tbody>
</table>

Primary operations: Funding and operation; financial years 2011-2013

- Publicly-funded (n=12,774)
- Privately funded (n=3,988)


i. Privately funded comprises those patients who have paid for their own operation (*Self-pay*) and a small cohort of patients with private medical insurance (*Private*).
Primary operations with complete comorbidity data:
Number of comorbidities and gender; financial years 2011-2013 (n=13,787)

- Female patients
- Male patients

Primary operations with complete comorbidity data:
Changes in the average number of comorbidities over time (n=20,356)

- Female patients
- Male patients
Comorbidity and BMI

It is not surprising to see that increasing BMI was associated with a significant increase in the average number of recorded comorbidities (one-way ANOVA; p<0.001). This has been previously reported for patients elsewhere in the world. The data confirm that as the degree of obesity increased its debilitating and life-limiting consequences similarly continued to increase.

Primary operations where all comorbidity data-items are complete: number of comorbid conditions and initial BMI; financial years 2011-2013

<table>
<thead>
<tr>
<th>Number of comorbid conditions</th>
<th>0-1</th>
<th>2-3</th>
<th>4-5</th>
<th>6-7</th>
<th>&gt;7</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial BMI / kg m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;40.0</td>
<td>581</td>
<td>709</td>
<td>423</td>
<td>118</td>
<td>16</td>
<td>1,847</td>
</tr>
<tr>
<td>40.0-44.9</td>
<td>662</td>
<td>1,132</td>
<td>820</td>
<td>296</td>
<td>71</td>
<td>2,981</td>
</tr>
<tr>
<td>45.0-49.9</td>
<td>565</td>
<td>1,235</td>
<td>1,047</td>
<td>442</td>
<td>105</td>
<td>3,394</td>
</tr>
<tr>
<td>50.0-54.9</td>
<td>417</td>
<td>1,035</td>
<td>853</td>
<td>404</td>
<td>96</td>
<td>2,805</td>
</tr>
<tr>
<td>&gt;54.9</td>
<td>320</td>
<td>958</td>
<td>874</td>
<td>424</td>
<td>114</td>
<td>2,690</td>
</tr>
<tr>
<td>Unspecified</td>
<td>18</td>
<td>31</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>All</td>
<td>2,563</td>
<td>5,100</td>
<td>4,032</td>
<td>1,688</td>
<td>404</td>
<td>13,787</td>
</tr>
</tbody>
</table>

Primary operations with complete comorbidity data:
Number of comorbidities and BMI; financial years 2011-2013 (n=13,717)

Here is evidence that there is a genuine and sustained increase in the numbers of comorbidities per patient, year on year over the last 5-8 years. This increase in the burden of comorbid disease is present across all the BMI groups, which means this effect cannot be simply explained away by the assertion that surgeons are selectively treating more and more patients in the super-obese category.

On average, patients presenting for bariatric surgery are becoming sicker.
Primary operations: Gender and the rates of the various comorbid conditions recorded in the database; financial years 2011-2013

<table>
<thead>
<tr>
<th>Comorbid condition</th>
<th>Male patients</th>
<th>Female patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atherosclerosis</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Liver disease</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Polycystic ovary syndrome</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Sleep apnoea</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Asthma</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Depression</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>GORD</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>Arthritis</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Poor functional status</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Younger bariatric surgery patients

This is the first in-depth description of bariatric surgery in patients under the age of 25 years old in the United Kingdom. Remarkably, there were 62 patients aged ≤18 years having this kind of surgery during the three-year period 2011-2013.

For all those under the age of 25 years, the young patients’ initial BMI spanned the range 31-81 kg m⁻², with an average of 48.7 kg m⁻². The age-specific distributions of initial BMI show that their median BMI generally fell within the range 44-49 kg m⁻².

Primary operations: age at operation, gender and BMI; calendar years 2011-2013

<table>
<thead>
<tr>
<th>Initial BMI / kg m⁻²</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;35.0</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>35.0-39.9</td>
<td>4</td>
<td>49</td>
</tr>
<tr>
<td>40.0-44.9</td>
<td>23</td>
<td>95</td>
</tr>
<tr>
<td>45.0-49.9</td>
<td>28</td>
<td>119</td>
</tr>
<tr>
<td>50.0-54.9</td>
<td>15</td>
<td>89</td>
</tr>
<tr>
<td>55.0-59.9</td>
<td>20</td>
<td>47</td>
</tr>
<tr>
<td>60.0-64.9</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>&gt;64.9</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Unspecified</td>
<td>108</td>
<td>3,973</td>
</tr>
</tbody>
</table>

All 108  3,973  6  462  12,373  34
These graphs describe the proportion of patients in each BMI group for the younger patients compared to older patients. It is a reflection on society’s failings that these patients had already gained sufficient weight to be broadly comparable to patients who are much older. This is true for both male and female patients. Overall, 39.5% of young male and female patients combined were already classified in the super-obese category with a BMI of 50 kg m$^{-2}$ or more. This represents clear failure of strategies to prevent weight gain in young people.
Primary operations: Patterns of post-operative stay for the three most common operations; financial years 2011-2013 (n=14,730)

Primary operations: Changes in average post-operative stay over time for the three most common operations (n=22,189)
Excess weight loss

Excess weight loss for the most common operations

The aim of bariatric surgery is to improve the overall health of patients by ameliorating, curing or preventing the development of the many diseases associated with obesity. In this regard weight loss is not a primary aim of surgery. However, weight loss is a convenient and important proxy measure of the effectiveness of surgery.

In order to allow comparisons of the degree of weight loss achieved between patients with differing pre-operative weights, it is common to express weight lost as the percentage of excess weight loss (%EWL; see page 52). The NBSR Committee entirely accepts the limitations of reporting weight loss in this way. Other mechanisms of reporting such as absolute weight loss (kg) or percentage total body weight loss (%) may be preferable. In addition, because of the mathematic variations, the starting weight (kg) should always be stated. As weight is collected as part of the NBSR dataset future reports will allow different ways of reporting these data, as current convention dictates.

The graphs below depict the remarkable success of all three commonly-performed bariatric operations in producing significant and sustained weight loss for up to three years. The degree of excess weight loss was greatest after the Roux-en-Y gastric bypass operation (around 55-70% %EWL), followed by sleeve gastrectomy (55-60% %EWL) and was least after gastric banding (45-55% %EWL). These results are similar to those in the international literature.

For each kind of operation, on average, men lost less of their excess weight than women; these data are similar to those reported by others. The reason for this difference is unclear, but seems likely to be multi-factoral. For all three common operations, patients with a BMI of less than 50 kg m$^{-2}$ lose more excess weight than those with BMIs greater than 50 kg m$^{-2}$. This might be seen as evidence in support of a policy of operating on patients at an earlier stage in their disease process.

The last NBSR report detailed weight loss out to 2 years post-surgery; this report is able to report data out beyond 3 years. It is reassuring to see that weight loss was largely sustained over this additional year; indeed, it is interesting to note that for gastric banding weight loss continues up to three years, as would be expected from a review of the published scientific literature on this subject. After gastric bypass and sleeve gastrectomy patients’ weight loss seemed to plateau one year after the operation, and there was a slight weight regain between two and four years after gastric bypass. As sleeve gastrectomy was only adopted en masse more recently in the United Kingdom, the number of patients with follow up exceeding two years is small for this procedure (2%), making assessment of weight loss beyond two years difficult.

Primary operations: excess weight loss and gender for selected operations; operations in the financial years 2006-2013

<table>
<thead>
<tr>
<th>Gender &amp; follow up period / months</th>
<th>Operation</th>
<th>Gastric band</th>
<th>Roux-en-Y gastric bypass</th>
<th>Sleeve gastrectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EWL (95% CI)</td>
<td>Count</td>
<td>EWL (95% CI)</td>
<td>Count</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>21.2 (1.1)</td>
<td>453</td>
<td>33.2 (0.6)</td>
<td>1,525</td>
</tr>
<tr>
<td>6</td>
<td>30.8 (1.9)</td>
<td>275</td>
<td>55.2 (1.0)</td>
<td>816</td>
</tr>
<tr>
<td>12</td>
<td>36.0 (2.1)</td>
<td>319</td>
<td>64.4 (1.2)</td>
<td>914</td>
</tr>
<tr>
<td>24</td>
<td>43.5 (3.6)</td>
<td>131</td>
<td>66.1 (1.8)</td>
<td>378</td>
</tr>
<tr>
<td>36</td>
<td>47.2 (6.9)</td>
<td>63</td>
<td>58.1 (4.0)</td>
<td>111</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20.2 (0.5)</td>
<td>2,360</td>
<td>30.6 (0.3)</td>
<td>4,986</td>
</tr>
<tr>
<td>6</td>
<td>31.9 (0.8)</td>
<td>1,574</td>
<td>55.7 (0.6)</td>
<td>2,764</td>
</tr>
<tr>
<td>12</td>
<td>40.0 (1.0)</td>
<td>1,764</td>
<td>69.8 (0.6)</td>
<td>3,264</td>
</tr>
<tr>
<td>24</td>
<td>50.0 (1.7)</td>
<td>935</td>
<td>71.7 (1.1)</td>
<td>1,414</td>
</tr>
<tr>
<td>36</td>
<td>53.9 (3.0)</td>
<td>390</td>
<td>67.3 (2.3)</td>
<td>425</td>
</tr>
</tbody>
</table>
Selected primary operations: Post-operative excess weight loss; operations in financial years 2006-2013

- Gastric band
- Roux-en-Y gastric bypass
- Sleeve gastrectomy

Selected primary operations: Post-operative excess weight loss and gender; operations in financial years 2006-2013


Comorbid disease after surgery

As mentioned on page 138, the aim of bariatric surgery is to improve the overall health of patients by curing, improving or preventing the comorbidities associated with obesity. Hence the rate of resolution of such comorbidities is an important factor to consider when assessing the effectiveness of bariatric surgery.

The graphs that follow demonstrate remarkable and statistically significant rates of resolution for all major comorbidities after bariatric surgery. Most cases of resolution occurred within one year of surgery, and resolution rates are maintained or even increase over the second year after surgery. The rates described in this overview are for all bariatric operations considered together, individual operation-specific rates of resolution are described in the relevant, operation-specific sections of this report.

Prior to surgery over 70% of men and women had poor functional status; one year after surgery this rate had decreased to under 30%. The NBSR is the only registry we are aware of that records change in functional status over time. There is no other treatment for obesity, or perhaps any other disease, that remotely matches the effects of surgery in terms of providing improvement in functional status for patients.

Other comorbidities also resolved by similarly significant degrees: over 40% of women with high blood pressure had a normal blood pressure one year after surgery (23% resolution for hypertensive men); over 50% of type 2 diabetic men and women experienced resolution within one year; cases of high blood lipid levels also fell by similar amounts within the first year as did the proportion of patients with obstructive sleep apnoea.

The resolution of these life-limiting comorbidities is a remarkable achievement and improves each such patient’s quality of life to a large degree. Resolution of these comorbidities also caries very large economic benefits.
Changes in functional status

Although the least medical of all comorbidities measured, functional status is very important to patients as it contributes greatly to their quality-of-life, employment status and dependence upon carers, etc. Over 70% of patients had a decreased functional status pre-operatively; one year after surgery this had dropped to under 26%. This is a remarkable achievement not just for the individual patients, but also for wider society as there will be large economic benefits resulting from these patients’ reduced reliance upon State support and return to the workforce.

The degree of decreased functional status can be broken down further into patients who could climb one flight of stairs, half a flight or those who were wheelchair users/housebound. For each such sub-group of patients a large degree of functional improvement was seen: 70.4% of patients pre-operatively limited to 1 flight of stairs could climb three flights at one year post-operation; 85.9% of those limited to half a flight pre-surgery improved post-operatively and 53.8% of wheelchair or housebound patients saw some improvement in their functional status after their operation.

The functional status of patients in each such sub-group continued to improve up to three years after their operation. Changes in the rates of poor functional status occurred more quickly in patients with less severe obesity (as measured by the Edmonton Obesity Severity Score, EOSS), but even those with the most severe disease (EOSS 4) saw a dramatic improvement.

### Primary operations: changes in functional status 12 months after surgery and gender; financial years 2011-2012

<table>
<thead>
<tr>
<th>Gender and pre-operative functional status</th>
<th>Functional status 12 months after surgery</th>
<th>Can climb 3 flights of stairs</th>
<th>Can climb 1 flight of stairs</th>
<th>Can climb half a flight of stairs</th>
<th>Wheelchair user / Housebound</th>
<th>Unspecified</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td>187</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>443</td>
<td>636</td>
</tr>
<tr>
<td>Can climb 1 flight</td>
<td></td>
<td>275</td>
<td>104</td>
<td>8</td>
<td>0</td>
<td>761</td>
<td>1,148</td>
</tr>
<tr>
<td>Can climb half a flight</td>
<td></td>
<td>113</td>
<td>43</td>
<td>17</td>
<td>1</td>
<td>327</td>
<td>501</td>
</tr>
<tr>
<td>Housebound</td>
<td></td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>10</td>
<td>45</td>
<td>62</td>
</tr>
<tr>
<td>Unspecified</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>222</td>
<td>227</td>
</tr>
<tr>
<td>3 flights</td>
<td></td>
<td>684</td>
<td>25</td>
<td>3</td>
<td>1</td>
<td>1,611</td>
<td>2,324</td>
</tr>
<tr>
<td>1 flight</td>
<td></td>
<td>925</td>
<td>374</td>
<td>18</td>
<td>1</td>
<td>2,578</td>
<td>3,896</td>
</tr>
<tr>
<td>Half flight</td>
<td></td>
<td>281</td>
<td>168</td>
<td>78</td>
<td>3</td>
<td>908</td>
<td>1,438</td>
</tr>
<tr>
<td>Housebound</td>
<td></td>
<td>7</td>
<td>18</td>
<td>18</td>
<td>33</td>
<td>141</td>
<td>217</td>
</tr>
<tr>
<td>Unspecified</td>
<td></td>
<td>7</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>602</td>
<td>616</td>
</tr>
</tbody>
</table>

i. Can climb 3 flights of stairs without resting.

ii. Can climb 1 flight of stairs without resting.

iii. Can climb half a flights of stairs without resting.

iv. Requires a wheelchair / housebound.
Improvements in functional status have not been studied before on the scale of a national registry. These remarkable data uniquely demonstrate the treatment effect of surgery. There is a left shift in the graphs starting with Can climb 1 flight and moving across the page to Housebound. In each of these graphs it is shown that at one year after surgery patients achieved a more active status, as described above.

In future reports we will be able to analyse whether poor functional status limits the ability of teams to follow up their patients.
Improvement in diabetes

Type 2 diabetes is a common and significant comorbidity in obese patients. It is expensive to treat and, even with optimum treatment, can result in potentially devastating complications such as myocardial infarctions, stroke, renal failure and peripheral vascular disease. Bariatric surgery has been recognized comparatively recently to be one of the most effective treatments for type 2 diabetes: it is the only treatment with the potential to achieve complete remission / resolution of the condition for significant numbers of patients. In doing so, bariatric surgery can offer significant financial savings to the healthcare economy, even when considering the cost of diabetic drugs alone.

The huge cost of treating diabetes has led to much focus on bariatric surgery as an effective treatment. There is good evidence from randomised controlled trials (RCTs) that surgery is superior to medical therapy in improving diabetes control and the metabolic syndrome. Surgery reduces the number of hypoglycaemic medications required, including getting patients off insulin. Simply considering the reduced costs of diabetes treatment, surgery pays for itself within 2-3 years. It also puts many into remission (normal HbA1c, normal fasting glucose, off all medication, relative risk 22.1) and markedly reduces incidence of diabetes compared to matched patients not having surgery. The gastric bypass has been called the equivalent of a free injection of GLP-1 for life. The International Diabetes Federation even recommends bariatric surgery as:

... an appropriate treatment for type 2 diabetes and BMI ≥35 not achieving recommended treatment targets with medical therapy, especially where there is other obesity-related comorbidity.

It is also accepted that the lower BMI threshold for surgery may be reduced by some 2.5 kg m\(^{-2}\) for patients from the Asian population, as this ethnic group has a greater susceptibility to diabetes and metabolic syndrome.

The following charts depict post-operative changes over time in the recorded rates of type 2 diabetes for patients noted to have any clinical indication of diabetes pre-operatively. Each chart demonstrates a substantial and progressive increase in the number of these patients reported as having no clinical indication of diabetes i.e., those noted to be no longer diabetic. At one year post-operation over 60% of previously diabetic patients can be considered to no longer be diabetic, this proportion continues to increase for up to three years. These remarkable results compare well with published results from around the world.

Interestingly, the cohort of type 2 diabetic patients with lower pre-surgery BMIs (below 45 kg m\(^{-2}\)) have a slower and reduced rate of reversion to a non diabetic state than those with BMIs >45 kg m\(^{-2}\) \((p<0.001; \log\text{-rank test})\). Future NBSR reports will be able to analyse whether this is due to worse diabetes status in those with lower BMIs.

Primary surgery for patients with an indication of diabetes prior to surgery: Changes in rates of recorded diabetes per BMI group; financial years 2011-2013

- <45.0 kg m\(^{-2}\) (n=1,009)
- 45.0-49.9 kg m\(^{-2}\) (n=985)
- 50.0-54.9 kg m\(^{-2}\) (n=756)
- >54.9 kg m\(^{-2}\) (n=695)
As type 2 diabetes becomes more severe or advanced, the treatment required to control the disease progresses from dietary control (recorded as impairment: glycaemia or glucose tolerance), through oral hypoglycaemics to insulin treatment for the most severely-affected patients. The graph below demonstrates that over a three-year post-operative period the patients requiring insulin before surgery were less likely to revert to a non-diabetic state than patients requiring oral hypoglycaemics ($p<0.001$; log-rank test); this cohort of patients in turn had lower resolution rates than patients treated by diet control alone ($p=0.022$; log-rank test). This has been reported previously and is, perhaps, not surprising, as one might expect any treatment to be less successful the more advanced the condition at the outset.

We believe these are the first data to demonstrate this on the scale of a national real-world registry in over 3,000 patients.
Although not shown here, an analysis of the patients who managed their diabetes using diet control alone showed that their duration of diabetes did not impact on the time to remission of the diabetic state. The two graphs below show that type 2 diabetic patients on pre-operative oral hypoglycaemic treatment and insulin therapy both have a greater likelihood of their diabetes resolving the shorter the duration of their diabetes (hypoglycaemic treatment group: <3 years duration versus 3-5 years p=0.002, log-rank test; <3 years versus >5 years and 3-5 years versus >5 years p<0.001, log-rank test; insulin therapy group: all comparisons different with p<0.001, log-rank test). These are the first data worldwide to demonstrate these changes in such large numbers.
This graph indicates that it is weight loss per se rather than the time after surgery that is associated with improvement in diabetes. The graph shows the potential of a small dataset to produce influential data from thousands of data entries.

It is important to remember that these data include patients from all 3 of the common operations groups: more work is needed to confirm or refute the observations that weight loss alone could be the important factor in improvement in diabetes.
Post-operative stay

Post-operative stay after laparoscopic gastric bypass is similar to that after laparoscopic sleeve gastrectomy, but, as expected, longer than after laparoscopic gastric banding. Hospital stay was longer for patients undergoing open Roux-en-Y gastric bypass \((p<0.001; \chi^2 \text{ test})\), but these procedures accounted for a minority (8%) of all the bypass procedures recorded in the NBSR.

It is worth noting that over 50% of laparoscopic gastric bypass patients stayed in the hospital for just 2 days and a further 25% stayed for just 3 days. Equally noteworthy are the 10% of gastric bypass patients whose hospital stay was a meagre 1 day. Shorter hospital stay has multiple benefits in terms of improving the patient’s overall experience and reducing the cost of care.