

The British Association of Endocrine & Thyroid Surgeons



Fourth **National Audit** **Report**

2012

Prepared by

David Chadwick BM BCh FRCS MD
*on behalf of the British Association
of Endocrine & Thyroid Surgeons*

Robin Kinsman BSc PhD
Peter Walton MA MBA FRCP
Dendrite Clinical Systems

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- building, maintaining & hosting the web registry
- data analysis and
- publishing this report.

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e-mail publishing@e-dendrite.com

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Foreword

Endocrine disease is complex and so is much of the associated surgery. In my foreword to the last report I highlighted my view that

... all surgeons have a professional, moral and social responsibility to know what they are doing and how well they are doing it ...

because such knowledge underpins the quest for excellence in surgical endeavour and gets to the heart of surgical professionalism.

So, collecting and contributing data to this audit should be seen as a professional duty: a hallmark of a responsible endocrine and thyroid surgeon. Since the publication of the last report there has been a greater drive towards transparency of healthcare data, which will enhance the standing of reports such as this, but it will also raise legitimate questions regarding those surgeons who are not contributing.

The NHS is going through massive change. The three underlying principles are: firstly, to make clinical outcomes the currency of the NHS, secondly, to give clinicians a greater say in how services are delivered and, thirdly, to give patients a greater say in their own treatment.

Clinical audits and on-going registries will have an increasing role to play as clinical outcomes are more closely linked to commissioning of services, organisational financial incentives and reconfiguration of services. At a more individual level the benchmarking of personal activity and outcomes will help with revalidation and the acquisition of clinical excellence awards.

The British Association for Endocrine and Thyroid Surgeons should be congratulated not only for maintaining momentum with this 4th report, but also for insisting that only those surgeons who genuinely seek to understand their practice, analyse their outcomes and contribute to a national body of knowledge are deserving of membership.

Prof. Sir Bruce Keogh

NHS Medical Director and National Medical Director NHS Commissioning Board



Introduction

This fourth Report of the BAETS National Audit continues to impress. It now details outcomes of almost 29,000 endocrine surgical procedures and, in line with previous audits, it continues to record levels of surgical activity, analyse training and degrees of sub-specialisation as well as comment on both short- and long-term outcomes after endocrine surgery.

The report highlights some important trends with regards to decreases in length-of-stay and in some complication rates such as hypocalcaemia after thyroidectomy (albeit with the incorporation of new definitions for early and late hypocalcaemia). Multivariate analysis has highlighted those factors affecting complications, and shows for example that early hypocalcaemia is increased by lower age, female gender, Graves' disease and level VI dissection. However, the rate of late hypocalcaemia still exceeds 10%.

While some of the results are encouraging with regards to audit involvement and to the use of MDT discussion, outcomes for FNAC are less than ideal (which probably has contributed to an unnecessary increase in surgery rates). In addition, there still remains no consensus regarding the use of laryngoscopy (either pre- or post-operatively), with a large variation between members in both the use and reporting of this investigation particularly when it comes to revision surgery. Also, in line with previous reports, a significant number of surgeons continue to operate on small numbers of cases of medullary thyroid cancer, as well as cancer in children.

Another important observation of the audit relates to trends in technology, and it is interesting to note that less than 20% of members regularly use the nerve monitor, and early enthusiasm with the harmonic scalpel is now being matched by an increased use of the ligasure device. Other highlights of the audit focus on the use of pre-operative imaging and localisation studies for surgery for hyperparathyroidism. In the future, it should be possible (in line with recent publications) to evaluate surgical complications in relation to increasing age of the surgeon. This will be interesting.

One of the strengths of this audit will be to facilitate the appraisal and revalidation process. This means we will need to provide members with their personal results in an appropriate format (largely funnel plots), which will allow comparison with national benchmarking data. However, before we can do this, we will need to refine the findings from multivariate analysis, to allow adjustment of outcomes by case-mix. We can only do this if the data are robust, so one of the aims of the society, over the next few years, will be to improve data collection using a number of methods such as mandatory fields, which will make it impossible to log off without completion, as well as making data submission compulsory for membership.

This audit remains a balance between collecting sufficient minimum data to provide worthwhile analysis, and the burden of over-collection. Its limitations include the fact that it is purely a surgical database, so that data on for instance adjuvant therapies for thyroid cancer or for tumours not undergoing surgery are not collected. Also, the majority of thyroidectomies in the United Kingdom are performed by non-BAETS members, and therefore are not recorded in our audit. Nationally, there are moves to improve data collection on thyroid cancer treatment, both surgical and non-surgical, via existing data sources collected by NHS Trusts and Cancer Registries. The BAETS is currently working in collaboration with the NCIN to advance this process, and this can only be in our best interests.

The success of this audit is dependent upon members submitting their data, and I am grateful to you all for doing this and hopefully in the future submission rates will improve further. In addition I would also like to congratulate David Chadwick for putting this excellent audit together, in combination with Dendrite who continue to provide the data analysis and publish the report, which allows us to continue this unique prospective evidence base.

Happy reading!

John Watkinson

President, British Association of Endocrine and Thyroid Surgeons



Executive summary

This is the fourth report of the BAETS National Audit, detailing outcomes of almost 29,000 endocrine surgical procedures accrued since inception of the audit until April 2011. Data for analysis were extracted in November 2011, allowing for a full 6 months to have elapsed and therefore for late / follow-up outcomes to be recorded.

Since the last report in 2009, some modifications have been made to the database, in particular:

- Incorporation of firmer definitions for early and late hypocalcaemia after thyroidectomy.
- Changes in the fields for post-operative vocal cord assessment, to improve comparisons between members and assess the reliability of estimates of recurrent laryngeal nerve injury rates.
- Changes in cancer staging systems, incorporating TNM version 7 in place of version 5.

As in previous reports, some of the data presented encompass the whole database, while others relate to the last 3 years or last financial year, allowing comparison of trends in outcomes over time and for the published figures to represent the most up-to-date data.

The database continues to expand, indeed at an increasing rate, and members are commended for their efforts in entering data, thereby making the audit a powerful tool for establishing a national benchmark for outcomes of endocrine surgery.

A number of new features have been included in this report, in particular items addressing the possible ultimate role of the audit data in revalidation / appraisal. Foremost amongst these are issues of data quality and of risk stratification.

To this end, sections have been added on:

1. Data quality, particularly missing data.
This section demonstrates considerable variation between members in completeness of data entry, independent of workload. This variation, and the level of missing data overall, has the potential to compromise assessment of surgical outcomes. Discussion needs to take place amongst the membership as to how this issue might best be resolved in future.
2. Multi-variate analysis of outcomes after thyroidectomy, with a view to ultimate production of a method of risk-stratification / adjustment, which might allow members' individual results to be adjusted for case-mix.

The main findings from the data analysis are:

Thyroid Surgery

- The total number of thyroid cases in the database is now 18,904.
- Most thyroid surgery is performed for benign indications; colloid goitre and Graves' disease together accounting for over 50% of cases.
- Total thyroidectomy has largely replaced bilateral subtotal thyroidectomy as the treatment of choice for thyrotoxicosis.
- For euthyroid patients, the commonest indications for surgery remain biopsy result and compressive symptoms. For retrosternal goitre the vast majority of operations are performed for compressive symptoms.
- Most thyroid cancer is of papillary subtype, and the large majority of cases are Stage 1. There is evidence of more advanced T-stage for Hürthle-cell and medullary cancers.
- There appears to be no consensus on the use of laryngoscopy either pre- or post-operatively, with huge variation between members in use of and reporting of this investigation. This raises doubt as to the accuracy of any estimates of recurrent laryngeal nerve palsy generated by the audit, and hampers comparison between members with respect to this most important outcome measure.



- Fine needle aspiration cytology (FNAC) remains the mainstay of pre-operative diagnosis, but its relatively low definitive diagnosis rate (C5/Thy5) results in many cancer diagnoses only being made by diagnostic surgery, largely lobectomy. When a C5/Thy5 result is obtained, however, the likelihood of total thyroidectomy and lymph node dissection at the first procedure significantly increases.
- MDT discussion prior to the first operation appears to increase the proportion of cancers undergoing total thyroidectomy at the first procedure, if cytology is equivocal.
- Data on lymph node dissection have been included in more detail. There seems to be no consensus on the use of level VI dissection, particularly in PTC.
- There has been an increase in the use of alternate technologies for tissue dissection / sealing, particularly Harmonic scalpel and Ligasure devices. Nerve monitoring remains relatively uncommon.
- Length-of-stay after thyroid surgery has declined in recent years, with most patients staying in hospital for only 24 hours. True daycase surgery (same-day discharge), however, remains uncommon. Management of hypocalcaemia seems to be a common reason for longer stays.
- Multi-variate analysis of outcomes shows that:
 1. Bleeding after thyroid surgery is largely affected by extent of resection (bilateral subtotal > total > lobectomy) and increasing age.
 2. Early hypocalcaemia is increased by lower age, female gender, Graves' disease and level VI dissection.
 3. Late hypocalcaemia is largely dependent on level VI dissection, with those other factors that affect early hypocalcaemia becoming much less relevant.

Parathyroid surgery

- The total number of cases in the database is 8,619.
- The use of localization studies prior to parathyroid surgery continues to increase, with the great majority of primary HPT cases undergoing localization, largely with both nuclear medicine and ultrasound scanning.
- More detail has been included in this report on the utility of imaging, particularly its influence on use of targeted surgery and success rates of surgery (cure of hypercalcaemia). Overall, only around half of cases ultimately have targeted surgery.
- The overall rate of persistent hypercalcaemia after first-time surgery for primary HPT is 4.7%. Cure rates are reduced by MEN diagnosis and for re-operative surgery, and are improved by use of qPTH. Use of localization studies *per se* does not influence cure rates. However, when nuclear medicine scanning is performed a negative result predicts a significantly worse outcome. This effect persists in multi-variate analysis.
- Length-of-stay after parathyroid surgery continues to decline over time, with most patients staying <2 days. True daycases represent about 5%, with the majority being targeted operations.

Adrenal surgery

- The total number of adrenal cases is 1,359.
- The majority of surgery is performed for functioning tumours, particularly pheochromocytoma.
- There has been an increase since the last report in the incidence of surgery for tumours metastatic to the adrenal gland.
- Data have been included for the first time on malignancy rates in relation to functional status and lesion size. A significant number of lesions under 50 mm diameter were malignant, all either metastases or pheochromocytomas.



- Surgery was initially laparoscopic in >80% of cases, mainly by the trans-peritoneal route, and with increased use of *alternate technologies*, particularly the Harmonic scalpel. Length-of-stay was significantly shorter for laparoscopic than for open surgery.
- The conversion rate for laparoscopic surgery was 8.1%.
- The mortality rate was 0.6%.

Pancreatic surgery

- Only a further 7 operations for pancreatic endocrine disease have been entered since the 2009 report.
- Around one-third are performed laparoscopically, and, if so, length-of-stay is shorter.
- Mortality was zero.

In conclusion, the audit continues to expand and to provide interesting information on the surgical management of endocrine disease. With further increases in patient numbers and attention to improving data quality, accurate benchmarking and use of the audit data reliably to inform appraisal and revalidation cannot be far away.

David Chadwick

Director of BAETS Audit, April 2011



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Prelude

Basic principles of endocrine surgery

The following section is a brief synopsis that is intended to help those with a less comprehensive knowledge of endocrine surgery to more easily understand the data presented in this audit report. It is by no means an exhaustive text and is biased towards the data collected in the BAETS registry.

Thyroid

Basic anatomy and physiology

The thyroid gland is situated low in the midline of the neck in front of the upper three tracheal rings. It consists of a right and left lobe that are joined in the middle by an isthmus. Under the influence of thyroid-stimulating hormone (TSH), secreted by the anterior pituitary gland, the thyroid gland secretes thyroid hormones (T_4/T_3), which regulate the oxygen consumption of the tissues.

Pathology

There are essentially two basic disorders of the thyroid gland:

Endocrine dysfunction

Excess thyroxine production leads to thyrotoxicosis (hyperthyroidism). The commonest causes for this are:

- Graves' disease 85%.
- Toxic multi-nodular goitre 10%.
- Toxic adenoma 5%.

In all three of these conditions thyroid surgery is one option for definitive treatment.

Insufficient thyroxine production (hypothyroidism) is usually due to an **auto-immune thyroiditis** (Hashimoto's disease) and surgery is rarely indicated.

Enlargement of the thyroid gland (Goitre)

Goitre is common and is typically benign. Most patients have normal thyroid function (euthyroid). Surgery for benign goitre may be indicated when the goitre leads to compression of the trachea or oesophagus.

Figure 1. CT scans of a man with stridor in the presence of a goitre.

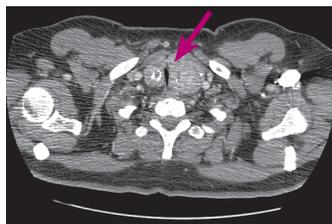


Figure 1a.
Cross sectional imaging.

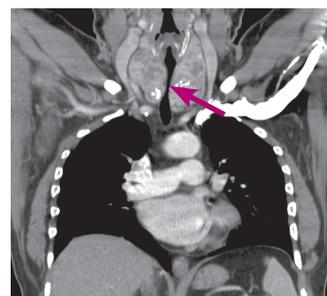


Figure 1b.
3D coronal reconstruction demonstrating narrowing of the trachea (arrows) at the level of the thyroid isthmus.



Thyroid cancer is rare (1 per 100,000 men, 3 per 100,000 women).

- 85% of cancers are described as differentiated and arise from the follicular thyroid cell. They are sub-divided into two forms: papillary (80%) and follicular (20%). Papillary thyroid cancers (PTC) often metastasise to local lymph nodes in the neck. Treatment for both sub-types involves thyroid resection, often with nodal dissection for PTC, followed by radio-iodine therapy.
- Medullary thyroid cancer accounts for 10% of thyroid cancers. These are derived from the C-cells of the thyroid and so radio-iodine therapy is ineffective. The best treatment is thyroidectomy with lymph node dissection. Approximately 25% of patients with medullary thyroid carcinoma have an inherited genetic mutation for multiple endocrine neoplasia type II (MEN-II).
- Anaplastic thyroid cancer and thyroid lymphoma are both exceedingly rare and surgery has a very limited role in the treatment of these conditions.

Thyroid cancers are staged pathologically on the basis of the **TNM classification**. The BAETS used the AJCC fifth edition (1997 used until October 2010).

TNM staging in version 5

T stage	T1	<1 cm
	T2	>1 cm & <4 cm
	T3	>4 cm
	T4	extra-thyroidal spread
	TX	unknown/cannot be defined
N stage	N0	negative lymph nodes
	N1	positive lymph nodes
	N1a	ipsilateral neck
	N1b	elsewhere
	NX	unknown
M stage	M0	no metastases
	M1	metastases
	MX	unknown

Overall stage in version 5

<45 years old	I	Any T/N with M0
	II	Any T/N with M1
>45 years old	I	T1, N0, M0
	II	T2/T3, N0, M0
	III	T4, N0, M0 or any T, N1, M0
	IV	Any T/N with M1



After October 2010, TNM version 7 has been used:

Basic principles

TNM staging in version 7

T stage	<p>pT0 No evidence of primary tumour</p> <p>pT1a ≤10 mm, limited to thyroid</p> <p>pT1b >10 mm and ≤20 mm, limited to thyroid</p> <p>pT2 >20 mm, ≤40 mm, limited to thyroid</p> <p>pT3 > 40 mm, limited to thyroid or any tumour with minimal extra-thyroidal extension</p> <p>pT4a Tumour invades beyond thyroid capsule and invades any of: subcutaneous soft tissues, larynx, trachea, oesophagus, recurrent laryngeal nerve</p> <p>pT4b Tumour invades pre-vertebral fascia, mediastinal vessels, or encases carotid artery</p> <p>pTX primary tumour cannot be assessed</p> <p>All anaplastic carcinomas are considered pT4 tumours</p>
N stage	<p>pNX unknown</p> <p>pN0 No regional nodes involved</p> <p>pN1a Metastasis in level VI lymph nodes</p> <p>pN1b Metastasis in other nodes (I-V,VII)</p>
M stage	<p>M1 Distant metastases proven histologically</p>

Overall stage in version 7

Papillary or follicular cancer		
<45 years old	1	Any T/N with M0
	2	Any T/N with M1
>45 years old	1	T1, N0, M0
	2	T2, N0, M0
	3	T3, N0, M0 or T1-3, N1a, M0
	4a	T1-3, N1b, M0 or T4a, any N, M0
	4b	T4b, any N, M0
	4c	Any T/N, M1
Medullary cancer		
Any age	1	T1, N0, M0
	2	T2-3, N0, M0
	3	T1-3, N1a, M0
	4a	T1-3, N1b, M0 or T4a, any N, M0
	4b	T4b, any N, M0
	4c	Any T/N, M1
Anaplastic cancer		
Any age		All anaplastic cancers are Stage 4



Investigations

1. Endocrine function – thyroid function tests.
2. Biopsy of a thyroid nodule. All patients who present with a new swelling in the thyroid should undergo a biopsy. This is undertaken using fine needle aspiration cytology (FNAC). There are 5 possible outcomes:
 - C1 Non-diagnostic.
 - C2 Non-neoplastic.
 - C3 Some features of PTC; follicular neoplasm.
 - C4 Suspicious for malignancy.
 - C5 Diagnostic of malignancy.
3. Imaging. This includes nuclear medicine, ultrasound and cross-sectional imaging with CT and MRI.

Figure 2. Neck ultrasound of a 19-year-old female with papillary thyroid cancer.

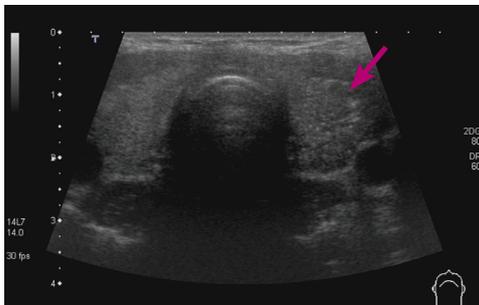


Figure 2a.

Demonstrating diffuse micro-calcification in a lesion in the left thyroid lobe characteristic of psammoma bodies (arrow).

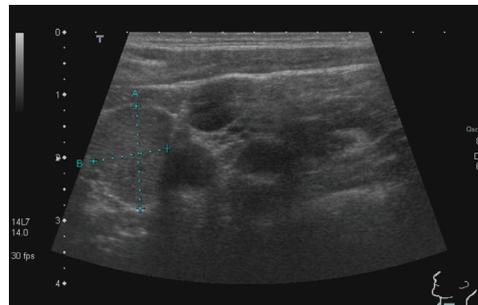


Figure 2b.

Illustrates a malignant-appearing node adjacent to the major vessels in left level III (with calliper markings).

Surgery

Thyroid surgery involves a variety of operations including:

- total thyroidectomy (right and left lobectomy).
- thyroid lobectomy.
- sub-total lobectomy.
- isthmusectomy (resection of only the isthmus).
- or a combination of these procedures.

Patients with cancer may also undergo clearance of the lymph nodes in the neck to a greater or lesser extent based on the pathology and stage of the disease.

Recognised specific complications of thyroid surgery include:

1. Haemorrhage in the early post-operative period, which can necessitate a re-operation.
2. Injury to the recurrent laryngeal nerve/ nerves. This may be temporary or permanent.
3. Injury to the parathyroid glands leading to hypocalcaemia, which requires replacement with calcium supplements and vitamin D. This may be temporary or permanent.

Complications are more likely to occur when an operation is carried out after previous surgery.

Parathyroid

Basic anatomy and physiology

There are usually four parathyroid glands, which are situated close to the thyroid gland. The superior pair are the more constant in position on the posterior border of the thyroid gland midway between the lower and upper poles of the thyroid gland. The inferior pair lie in a more variable position, usually within the thyro-thymic tract, a condensation of fascia between the thyroid gland and the thymus. The parathyroid glands secrete parathyroid hormone (PTH) in response to changes in calcium levels in the blood.

Pathology

Parathyroid disease is mostly concerned with overproduction of PTH leading to hyperparathyroidism (HPT). There are essentially two types of HPT:

- Primary hyperparathyroidism. This is an inappropriate hypersecretion of PTH leading to a high blood calcium level (*hypercalcaemia*). This is due to a tumour in one or more of the parathyroid glands. Most patients have a benign growth of one gland, but up to 15% may have a growth of two, three or all four glands. Parathyroid cancer is very rare (<1%). Primary HPT may also be seen in Multiple Endocrine Neoplasia Syndromes (MEN, types 1 and 2). These are inherited syndromes associated with tumours in various endocrine organs. In MEN-1, primary HPT is the commonest manifestation, and is more commonly associated with multiple parathyroid lesions (*multi-gland disease*). This often necessitates resection of multiple parathyroids, and potentially may lead to lower primary cure rates and higher risks of later recurrent HPT, compared to sporadic HPT. The only permanent way to return the blood calcium levels to normal in patients with primary HPT is resection of the abnormal parathyroid gland / glands (*parathyroidectomy*).
- Renal hyperparathyroidism. Patients with kidney failure are predisposed to an appropriate excess secretion of PTH that often does not lead to hypercalcaemia, but the excessive levels of PTH can cause symptoms. In this condition all four parathyroid glands become enlarged. Very high PTH and / or hypercalcaemia are indications for parathyroidectomy.

Figure 3. Pre-operative localisation images of a 69-year-old female with primary HPT using a nuclear medicine scan (MIBI) and neck ultrasound.

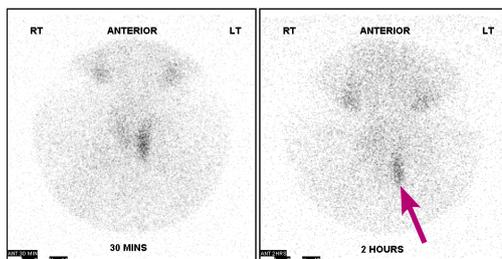


Figure 3a.

The early and delayed MIBI neck images localising an enlarged parathyroid gland to the inferior pole of the left thyroid lobe (arrow).

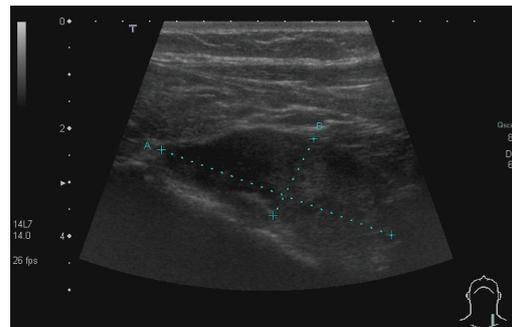


Figure 3b.

Illustrating the appearances of a parathyroid adenoma, which is in the same location (marked with callipers).



Investigations

1. Endocrine function (calcium and PTH).
2. Parathyroid localisation – using imaging to determine the location of the abnormal gland(s) once the biochemical diagnosis of HPT has been confirmed. There are various localising techniques:
 - Non-invasive** ultrasound, Scintiscan, MRI, CT.
 - Invasive** selective venous sampling, angiography.
 - Per-operative** methylene blue, isotope probe.

Surgery

Parathyroidectomy comprises removal of the abnormal gland/ glands. In patients with multiple-gland disease the surgeon makes a decision to resect two, three, three-and-a-half or all four glands. In addition to the pre-operative localisation techniques, there are some intra-operative techniques that some surgeons employ including localisation with intravenous methylene blue, localisation with an isotope probe and measurement of the PTH: the so-called quick PTH assay (qPTH).

Recognised specific complications of parathyroidectomy include:

1. Haemorrhage in the early post-operative period, which can necessitate a re-operation.
2. Injury to the recurrent laryngeal nerve/ nerves. This may be temporary or permanent.
3. A failure to cure the hyperparathyroidism, this may either be immediate or delayed (persistent or recurrent HPT).

As with thyroid surgery, complications are more likely to occur when an operation is carried out as a re-operative procedure after previous surgery.



Adrenal glands

Basic anatomy and physiology

The adrenals are paired glands that are situated superior to the kidneys in the retroperitoneum. Each gland is approximately 5 cm long, 3 cm wide and 1 cm thick. The gland has two functionally distinct units:

The adrenal cortex secretes three classes of steroid hormones :

1. Cortisol (glucocorticoid).
2. Aldosterone (mineralocorticoid).
3. Androgens (sex-steroids).

The adrenal **medulla** secretes catecholamines (adrenaline and noradrenaline).

Pathology

Tumours of the adrenal can be classified into two groups:

Functioning

Where the clinical presentation is dependant upon the effects of the excess production of steroid or catecholamine:

Cortex

- Glucocorticoid excess – manifests as **Cushing's** syndrome.
- Mineralocorticoid excess – manifests as **Conn's** syndrome.
- Sex steroid excess – manifests with virilizing features.

Medulla

- Catecholamine excess – **Phaeochromocytoma** (10% of these tumours arise outside the adrenal gland). Phaeochromocytoma is also a manifestation of MEN-II.

Non-functioning

- Benign adrenocortical adenoma – usually asymptomatic.
- Malignant adrenocortical carcinoma – often large and invading adjacent structures.

Adrenalectomy is the definitive treatment for functioning tumours.

Adrenalectomy is the first-line treatment for adrenocortical carcinoma.

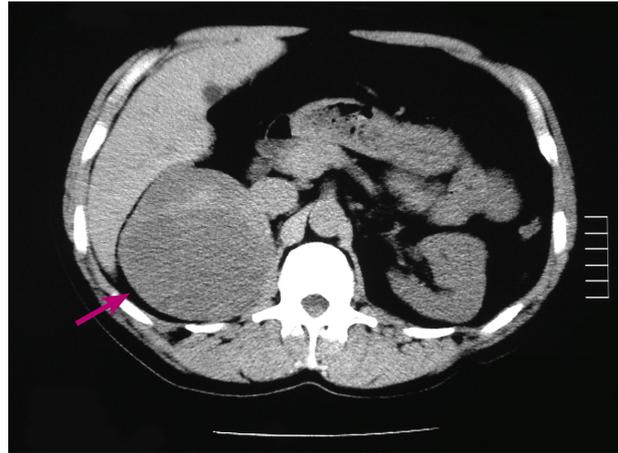
Non-functioning adrenocortical adenomas are generally managed conservatively until they reach a size that makes clinicians anxious that the tumour could be malignant (≥ 4 cm).



Investigations

1. Endocrine function – tests of the cortex and medulla.
2. Imaging.
 - a. Functional – nuclear medicine scans.
 - b. Anatomical – usually cross sectional with CT/MRI.

Figure 5. A cross sectional CT scan demonstrating a large right adrenal tumour (arrow) in a 35-year-old male with a biochemical diagnosis of a pheochromocytoma.



Surgery

Adrenal surgery involves resection of one or both adrenal glands dependant upon the pathology. The gold-standard approach is laparoscopic. Open surgery is still favoured for larger tumours or when malignancy is suspected.



Pancreas

Basic anatomy and physiology

The pancreas is a gland that lies in the retroperitoneal space across the midline. In addition to its exocrine function, approximately 2% of its cells are endocrine: the islets of Langerhans. These are distributed throughout the pancreas, but are more densely populated in the pancreatic tail. There are differing cell types within the islets that secrete insulin, glucagon, somatostatin and vasoactive intestinal peptide (VIP).

Pathology

Tumours of the endocrine pancreas are exceptionally rare.

- Insulinoma 1-2 per million.
- VIPoma 1 per 10 million.
- Glucagonoma 1 per 20 million.
- Somatostatinoma 1 per 40 million.

Each tumour has unique manifestations consequent upon the specific hormone excess.

5–10% insulinomas are associated with MEN-I.

Investigations

1. Endocrine function.
2. Imaging.
 - a. Anatomical – cross sectional CT / MRI, ultrasound (including endoscopic).
 - b. Functional – nuclear medicine, selective catheterization.

Figure 4. Magnified CT scan of the pancreas demonstrating enhancing lesion in the body of the pancreas in a 79-year-old female with a biochemical diagnosis of an insulinoma (arrow).



Surgery

Currently the conventional approach to pancreatic surgery is a laparotomy, but there is growing enthusiasm for a laparoscopic approach for small tumours. Insulinomas are typically small (<2 cm) and are either excised by enucleation or a distal pancreatectomy depending upon the relationship of the tumour to the pancreatic duct and splenic vessels.



A note on the conventions used throughout this report

There are a number of conventions used in the report in an attempt to ensure that the data are presented in a simple and consistent way. These conventions relate largely to the tables and the graphs, and some of these conventions are outlined below.

The specifics of the data used in any particular analysis are made clear in the accompanying text, table or chart. For example, many analyses sub-divide the data on the basis of placement intention, and the titles for both tables and charts will reflect this fact.

Conventions used in tables

On the whole, unless otherwise stated, the tables and charts in this report record the number of procedures (see the example below, which is a modified version of the table presented on page 41).

Thyroid surgery: age and gender distributions

		Gender				
		Male	Female	Unspecified	All	Proportion female
Age at surgery / years	<21	94	375	0	469	80.0%
	21-30	285	1,657	0	1,942	85.3%
	31-40	571	3,273	0	3,844	85.1%
	41-50	682	3,733	0	4,415	84.6%
	51-60	726	2,978	0	3,704	80.4%
	61-70	606	2,047	0	2,653	77.2%
	71-80	355	1,166	0	1,521	76.7%
	>80	66	284	0	350	81.1%
	Unspecified	1	5	0	6	83.3%
	All	3,386	15,518	0	18,904	82.1%

Each table has a short title that is intended to provide information on the subset from which the data have been drawn, such as the patient's gender or particular operation sub-grouping under examination.

The numbers in each table are colour-coded so that entries with complete data for all of the components under consideration (in this example both age and gender) are shown in regular black text. If one or more of the database questions under analysis is blank, the data are reported as **unspecified** in red text. The totals for both rows and columns are highlighted as emboldened text.

Some tables record percentage values; in such cases this is made clear by the use of an appropriate title within the table and a % symbol after the numeric value.

Rows and columns within tables have been ordered so that they are either in ascending order (age at procedure: <20, 20-24, 25-29, 30-34, 35-39, etc.; post-procedure stay 0, 1, 2, 3, >3 days; etc.) or with negative response options first (No; None) followed by positive response options (Yes; One, Two, etc.).

Row and column titles are as detailed as possible within the confines of the space available on the page. Where a title in either a row or a column is not as detailed as the authors would have liked, then footnotes have been added to provide clarification.

There are some charts in the report that are not accompanied by data in a tabular format. In such cases the tables are omitted for one of a number of reasons:

- insufficient space on the page to accommodate both the table and graph.
- there would be more rows and / or columns of data than could reasonably be accommodated on the page (for example, Kaplan-Meier curves).
- the tabular data had already been presented elsewhere in the report.



Conventions used in graphs

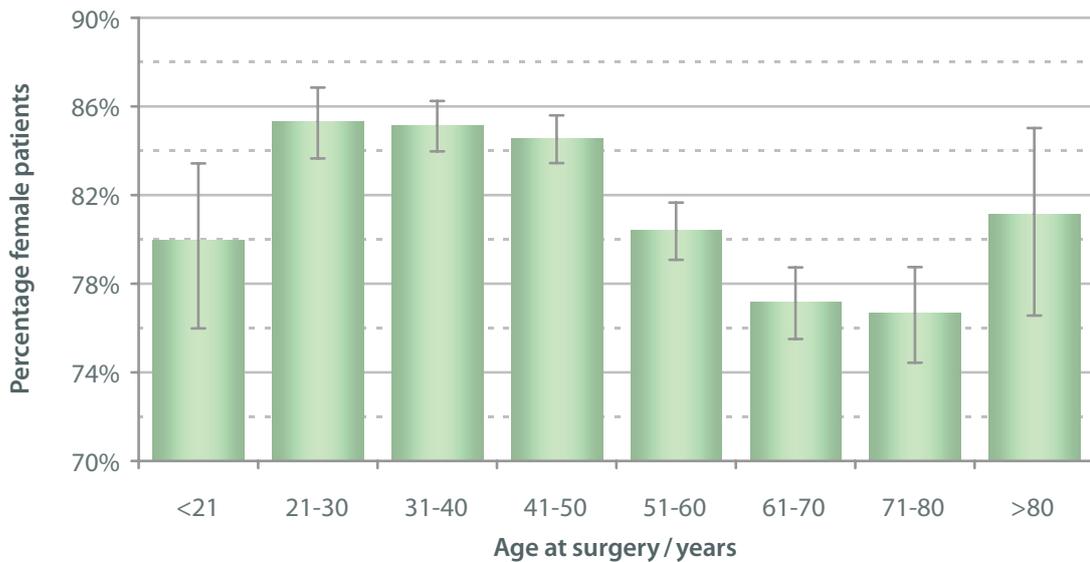
The basic principles applied when preparing graphs for this fourth BAETS Report were based, as far as possible, upon William S. Cleveland's book *The elements of graphing data* ¹. This book details both best practice and the theoretical bases that underlie these practices, demonstrating that there are sound, scientific reasons for plotting charts in particular ways.

Counts: The counts (shown in parentheses at the end of each graph's title as n=) associated with each graph can be affected by a number of independent factors and will therefore vary from chapter to chapter and from page to page. Most obviously, many of the charts in this report are graphic representations of results for a particular group (or subset) extracted from the database, such as thyroid surgery. This clearly restricts the total number of database-entries available for any such analysis.

In addition to this, some entries within the group under consideration have data missing in one or more of the database questions under examination (reported as unspecified in the tables); all entries with missing data are excluded from the analysis used to generate the graph because they do not add any useful information.

For example, in the graph on page 41 (reproduced below), only the entries where both the thyroid status and the kind of operation are known are included in the analysis; this comes to 18,898 patient-entries (94 + 285 + 571 + 682 + 726 + 606 + 355 + 66 + 375 + 1,657 + 3,273 + 3,733 + 2,978 + 2,047 + 1,166 + 284; the 6 entries with unspecified data are excluded from the chart).

Thyroid surgery: Age and gender (n=18,898)



Confidence interval: In the charts prepared for this report, most of the bars plotted around rates (percentage values) represent 95% confidence intervals ². The width of the confidence interval provides some idea of how certain we can be about the calculated rate of an event or occurrence. If the intervals around two rates do not overlap, then we can say, with the specified level of confidence, that these rates are different; however, if the bars do overlap, we cannot make such an assertion.

Bars around averaged values (such as patients' age, post-operative length-of-stay, etc.) are classical standard error bars or 95% confidence intervals; they give some idea of the spread of the data around the calculated average. In some analyses that employ these error bars there may be insufficient data to legitimately calculate the standard error around the average for each sub-group under analysis; rather than entirely exclude these low-volume sub-groups from the chart their arithmetic average would be plotted without error bars. Such averages without error bars are valid in the sense that they truly represent the data submitted; however, they should not to be taken as definitive and therefore it is recommended that such values are viewed with extra caution.

1. Cleveland WS. *The elements of graphing data*. 1985, 1994. Hobart Press, Summit, New Jersey, USA.
2. Wilson EB. Probable inference, the law of succession, and statistical inference. *Journal of American Statistical Association*. 1927; **22**: 209-212



Funnel plots

There are, of course, many different ways to display crude outcome data. When comparing outcomes for individuals, one method would be to calculate the outcome rate for each and then rank them in ascending order of outcome rate; it is possible to place 95% confidence intervals around the calculated rate to give some indication of the confidence in that result, but this method tends to draw the eye to the upper and lower reaches of the ranking and does not easily provide information on how each clinician sits with respect to the average outcome rate.

Another method would be to determine the rank-order for the surgeons based on crude or risk-adjusted outcome rates and then plot these ranks with suitable confidence intervals around them. This method will also tend to draw attention to the extremes of the ranking and can generate spurious results.

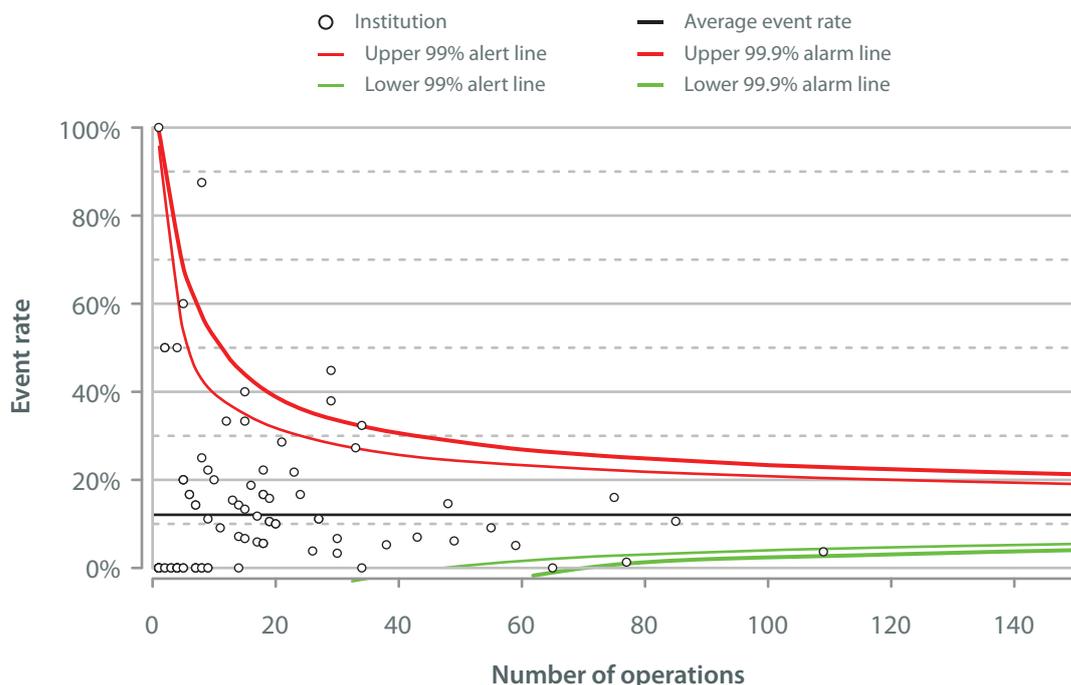
Shewhart control charts have been suggested as a means of presenting performance in the clinical setting without having to resort to such spurious ranking into league tables. These plots show the number of observed events against the volume of cases on a square-root scale; unfortunately this format is not intuitive, obscures the observed event rate and leads to rather approximate control limits. Applying a minor adjustment to this method (plotting the event rate against the number of cases) generates the so-called funnel plot, which is widely used in meta-analyses to check for publication bias and has been used to compare mortality rates in paediatric cardiac surgery. Exact binomial control limits around the overall rate are superimposed to indicate possible thresholds for alert and alarm respectively.

Funnel plots discourage inappropriate ranking while providing a strong visual indication of divergent performance or special cause variation; they are not a cause for damnation in and of themselves. Advantages over the Shewhart control charts approach include the display of the observed event rates, an informal check on the relationship between the event rate and number of cases, an emphasis on the natural increased variability amongst small-volume centres or individuals, intuitive choice of axes (hence easy plotting) and exact binomial control limits that can be calculated using the most popular spreadsheet packages. This method is, however, not risk-adjusted, and therefore has all the problems associated with not comparing like with like.

The example funnel plot below shows an event rate for a number of institutions (which might be a country, an individual hospital, a consultant surgeon, etc.). Each dot represents an institution, and shows the crude event rate *versus* the number of procedures performed. The solid, horizontal black line indicates the average rate. The 99% control limits are shown as thin (green and red) lines and 99.9% limits thick (red & green) lines.

It should be obvious that transgressing the upper limits when the case-number is small is very unlikely unless the complication rate is extremely high. Using such an approach should reduce the fear of making unjustified judgements based on small numbers of cases.

Example funnel plot





Contributors

- Anna **Aertssen**
- Avi **Agrawal**
- Afzaal **Ahmad**
- Murat **Akyol**
- Munther **Aldoori**
- David **Allen**
- Iain D **Anderson**
- Tim **Archer**
- Sebastian **Aspinall**
- Chris **Ayshford**
- Saba **Balasubramanian**
- Alistair **Balfour**
- Ludger **Barthelmes**
- Tom **Bates**
- Chris **Bem**
- Amir **Bhatti**
- Myles **Black**
- Stephen **Blair**
- Richard **Bliss**
- Victoria **Brown**
- Michael **Burke**
- Robert **Carpenter**
- David J **Cave-Bigley**
- David **Chadwick**
- Habib **Charfare**
- Louise **Clark**
- Richard **Collins**
- Luke **Condon**
- Rogan **Corbridge**
- Allan Paul **Corder**
- Stephen P **Courtney**
- Hugh **Cox**
- James N **Crinnion**
- David **Cunliffe**
- Jeremy P **Davis**
- Stuart **Denholm**
- Helen **Doran**
- Julie **Doughty**
- Julie **Dunn**
- Patricia **Durning**
- Fiona **Eatock**
- Wael **Elsaify**
- James **England**
- Abigail A **Evans**
- William R **Fleming**
- Clare **Fowler**
- John **Frewer**
- Ashu **Gandhi**
- Richard **Garth**
- Martin G **Greaney**
- Thomas G **Groot-Wassink**
- Andrew **Guy**
- Richard **Halpin**
- Robert **Hardy**
- Barney **Harrison**
- Micheal **Harron**
- Dugal **Heath**
- Simon **Hickey**
- Omar **Hilmi**
- Philip **Holland**
- Andrew **Houghton**
- Jonathan **Hubbard**
- Neil **Hulton**
- Paul **Hurley**
- Shaun **Jackson**
- Tony **Jacob**
- Taleb **Jeddy**
- Stephanie **Jenkins**
- Corinne **Jones**
- Nigel AG **Jones**
- Anton **Joseph**
- Bengt **Kald**
- Paul **Kirkland**
- Zygmunt **Krukowski**
- Vijay **Kurup**
- Nicholas RF **Lagattolla**



- Mark **Lansdown**
- Tom WJ **Lennard**
- Peter **Lewis**
- Andrew P **Locker**
- John RC **Logie**
- M **Lucarotti**
- John **Lynn**
- Alasdair **Mace**
- Paul R **Maddox**
- Zvoru **Makura**
- Andrew **Mccombe**
- Andrew **M'Irvine**
- Andrew J **M'Laren**
- Alasdair H **M'Lean-Ross**
- Sandy **M'Pherson**
- Radu **Mihai**
- Faisal MA **Mihaimed**
- Peter **Moore**
- Justin **Morgan**
- Muntzer **Mughal**
- Iain M **Muir**
- Michael L **Nicholson**
- Stewart **Nicholson**
- Keshav **Nigam**
- Olawale **Olarinde**
- Fausto **Palazzo**
- Michael **Papesch**
- Neil R **Parrott**
- Neville I **Ramus**
- David **Ratliff**
- David **Rew**
- Keith **Rigg**
- Gavin T **Royle**
- Robert **Ruckley**
- Sarwat **Sadek**
- Greg **Sadler**
- Mrinal **Saharay**
- Michael **Salter**
- Ahmed **Samy**
- David **Scott-Coombes**
- Anup Kumar **Sharma**
- Patrick **Sheahan**
- Steve **Shering**
- Richard **Sim**
- Prakash **Sinha**
- Anthony **Skene**
- James **Smellie**
- David M **Smith**
- Raj **Spence**
- Paul **Spraggs**
- Roly **Squire**
- Frank **Stafford**
- Michael P **Stearns**
- Michael **Stechman**
- Gareth **Tervit**
- Martin **Thomas**
- Paul **Thomas**
- William EG **Thomas**
- Adrian **Thompson**
- Steven **Thrush**
- Neil **Tolley**
- Mark **Tomlinson**
- Philip **Turton**
- Charanjeit S **Ubhi**
- Alison **Waghorn**
- Jonathan C **Watkinson**
- Andrew R **Welch**
- Hugh **Wheatley**
- Michael R **Williams**
- Richard **Windle**
- Michail **Winkler**
- Constantinos **Yiangou**
- Charles **Zammit**



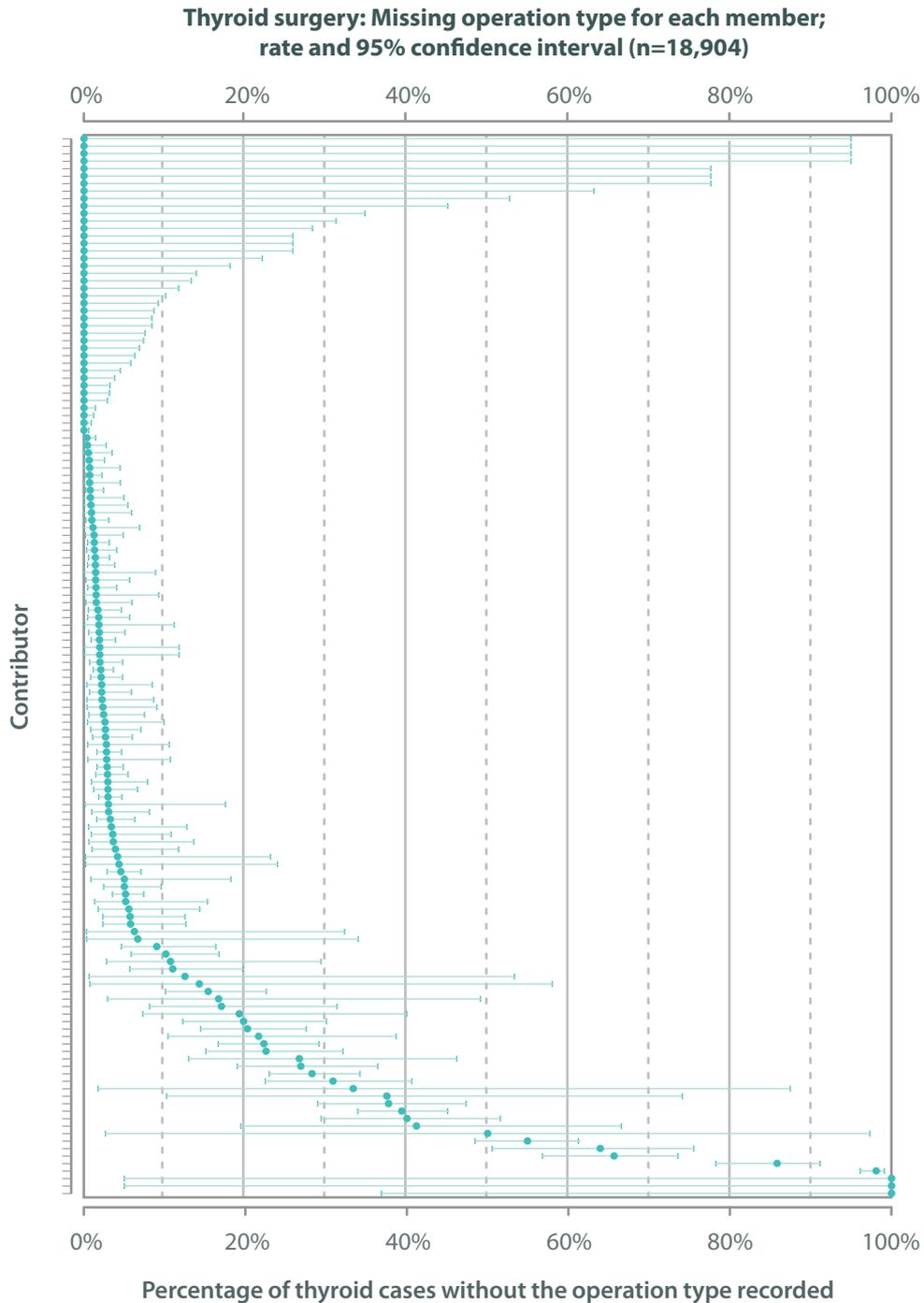
Missing data

In preparation for the use of the BAETS audit data for revalidation / appraisal purposes, details on data quality have been specifically included in this report. In particular, the extent of missing data on existing cases within the database is highlighted, and variability between members with respect to this issue.

Thyroid surgery data

Even for simple data, such as the details of what thyroid procedure had been performed, details are incomplete in some cases, as outlined here for each individual member.

Missing data



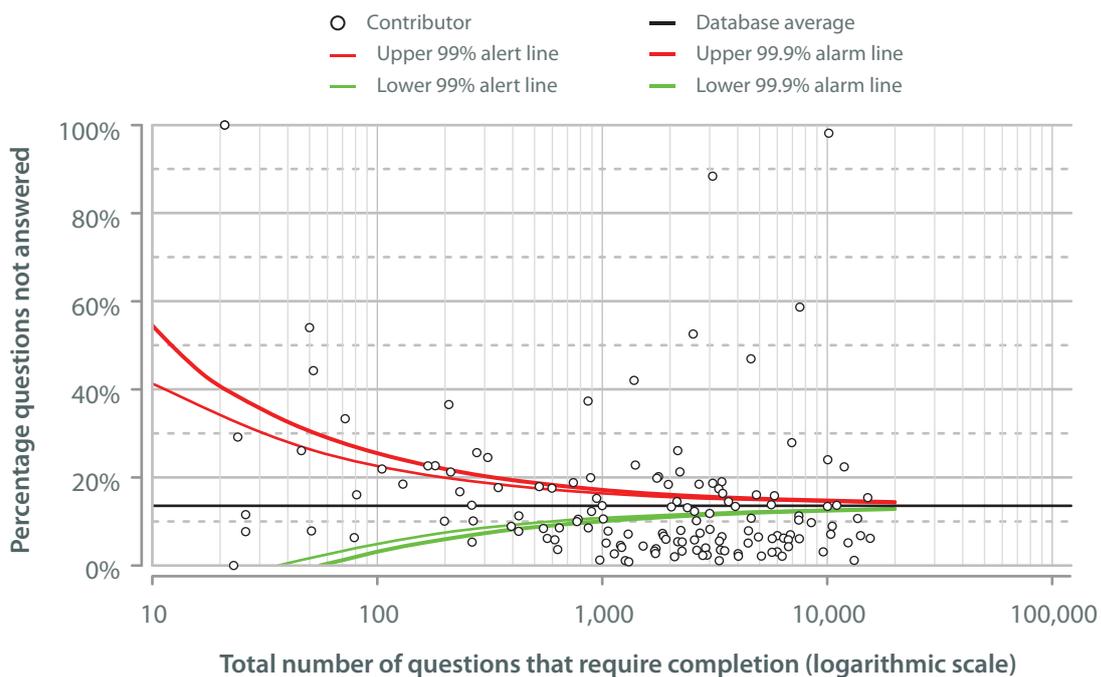
There appear to be a small number of members entering no / little information on the case, beyond date of birth, gender and endocrine case type. This dilutes the database with *uninterpretable* data and should be strongly discouraged.



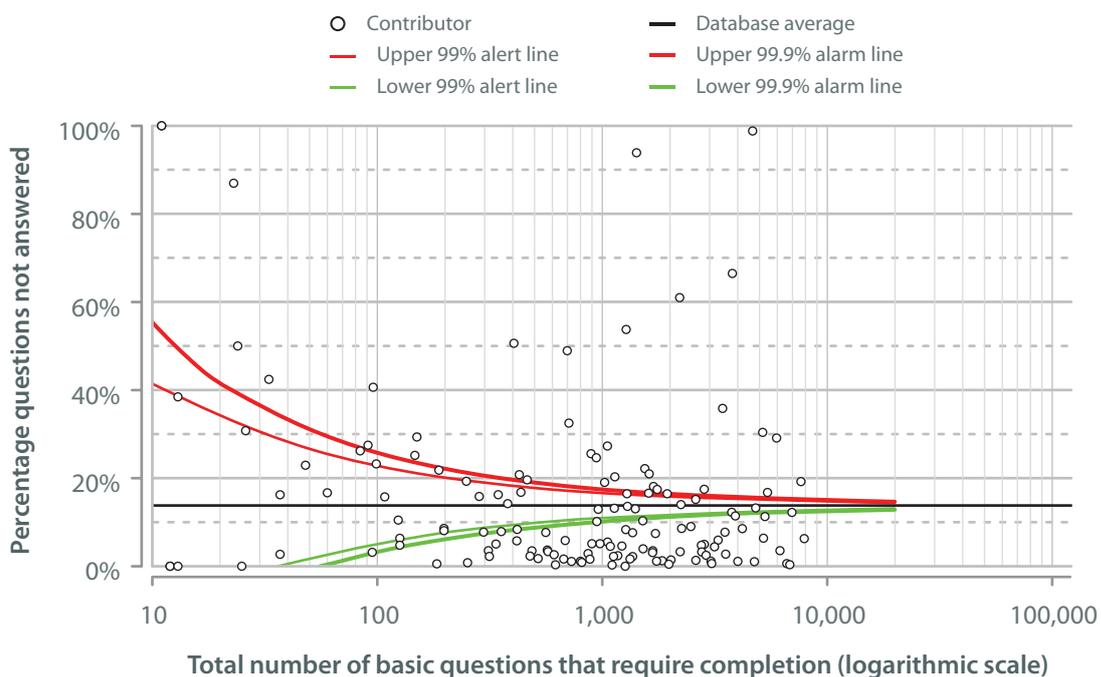
The following two funnel plots demonstrate the variation between members with respect to completeness of data entry, expressed as the proportion of the total number of potential data points (correlated with number of questions requiring data) left unanswered. The first plot refers to completion of all data fields, whilst the second refers only to those basic data which are essential for calculation of complication rates and correlation of these with extent of surgery.

In general, there is a high rate of completion of data, but there is considerable variation between members, with a significant number falling outside the upper alarm line. Many members, however, also fall outside the lower alarm line, combining high volumes of cases with excellent rates of data completion.

Thyroid surgery: Missing data (n=18,904 entries; 466,831 questions)



Thyroid surgery: Missing basic data (n=18,904 entries; 232,054 questions)





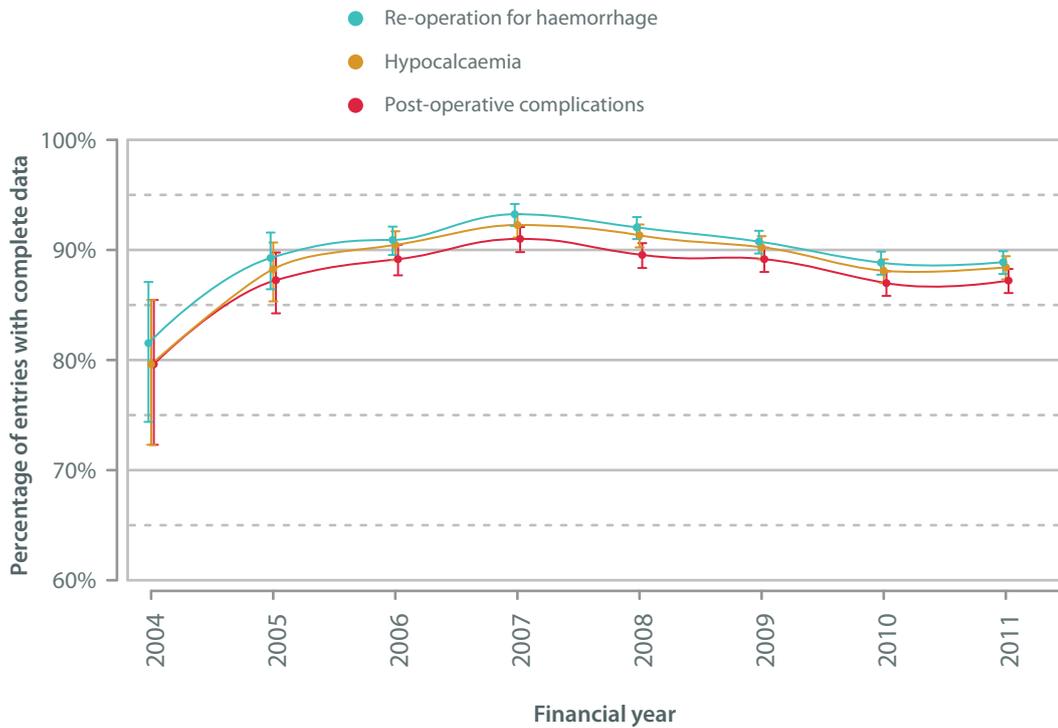
Changes in data completion over time

The following two graphs demonstrate changes in data completeness over time: the first chart is for in-patient complications, and the second for outcomes at follow-up.

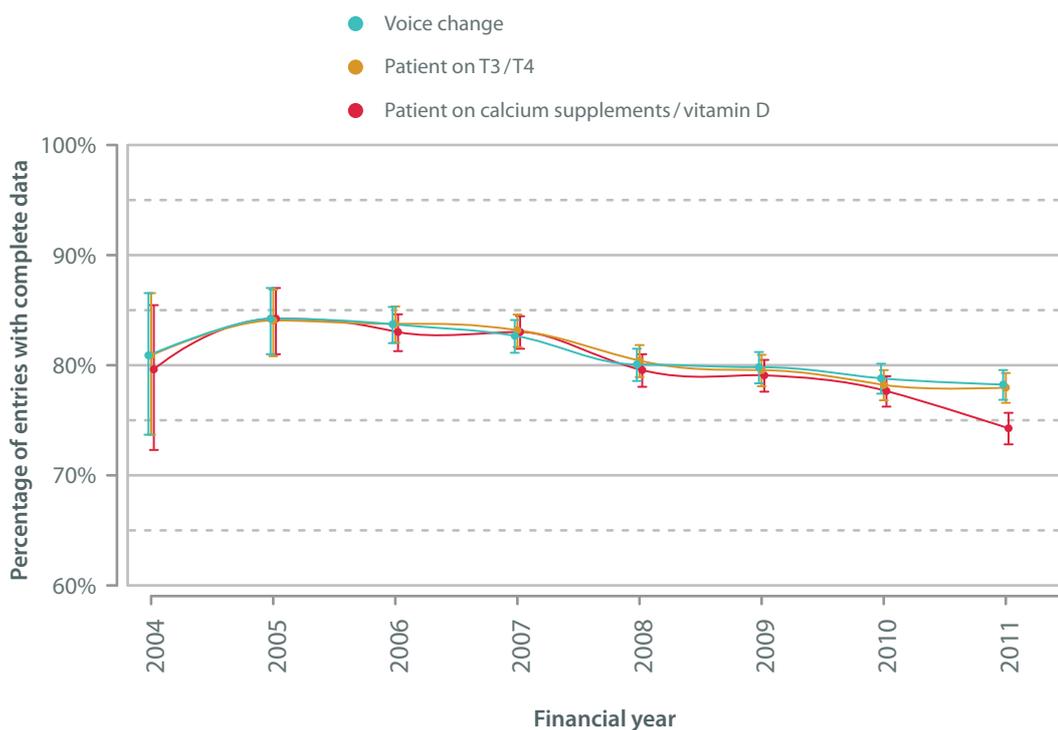
Generally, in-patient complications are reported more completely than those at follow-up, with fairly stable rates of completion over time for both sets of data.

Missing data

Thyroid surgery: Rates of complete data over time; discharge details (n=18,548)



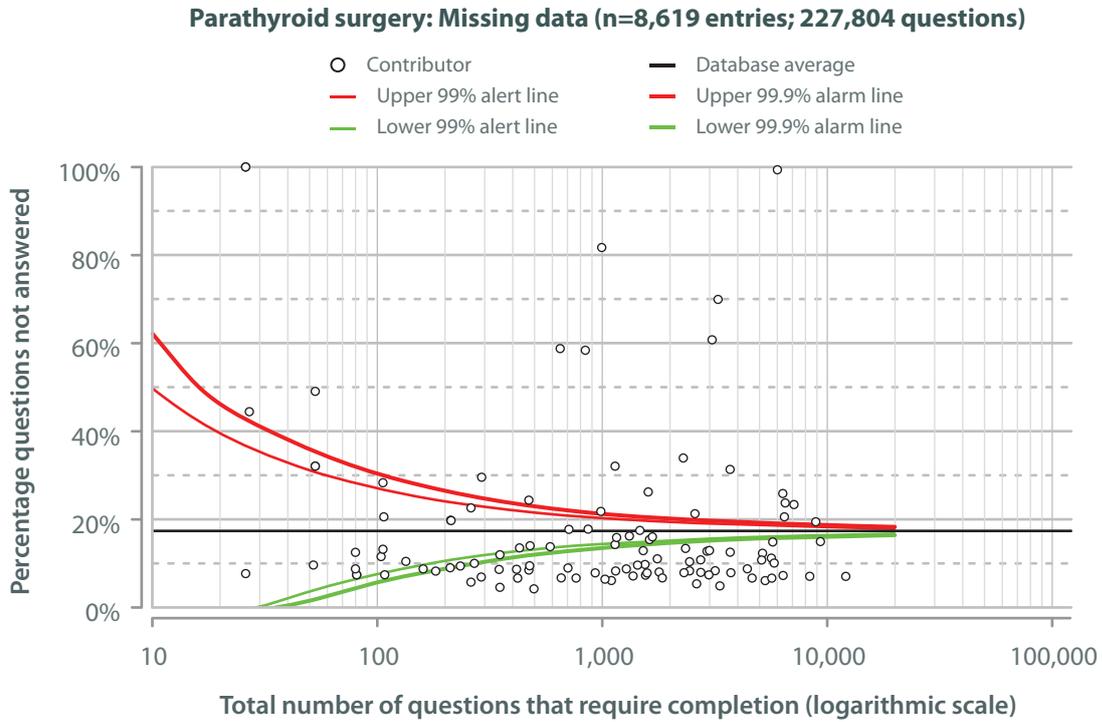
Thyroid surgery: Rates of complete data over time; follow up details (n=18,548)





Parathyroid surgery data

Data completeness for parathyroid surgery shows a similar pattern to that for thyroid surgery.



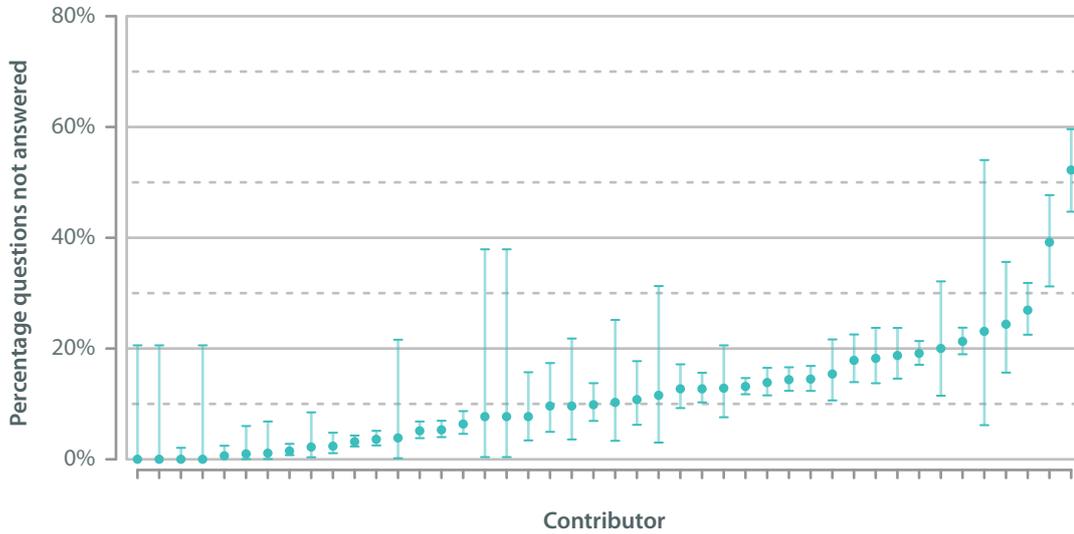


Adrenal surgery data

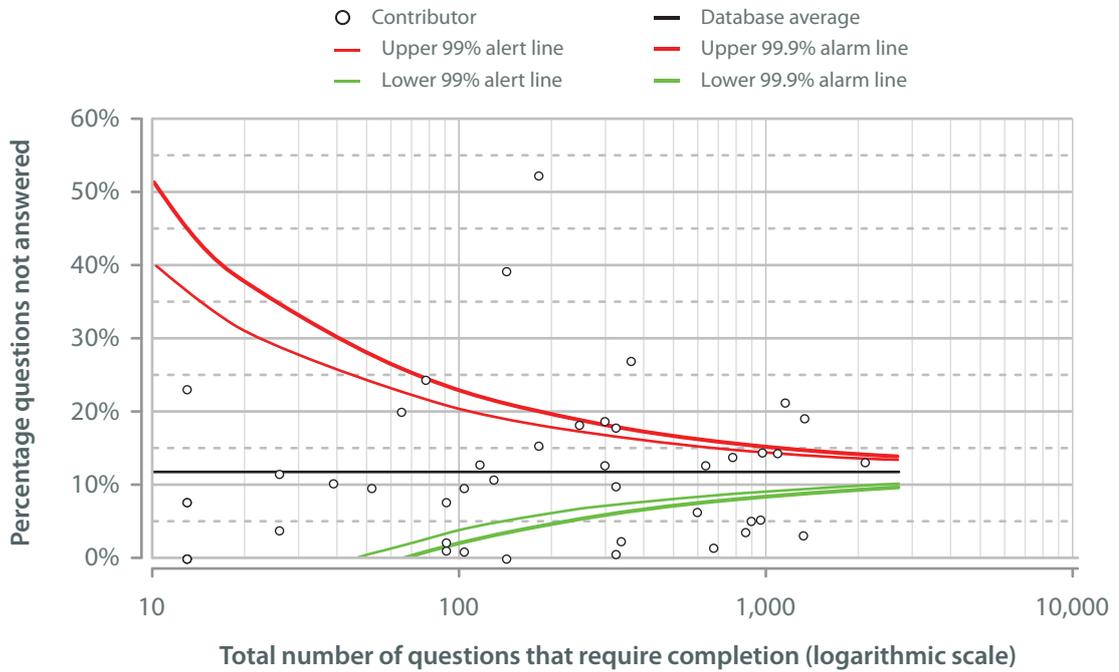
For adrenal surgery, overall rates of data completeness are marginally higher, perhaps reflecting the smaller number of fields requiring completion. Variation between members, however, remains a significant issue.

Missing data

Adrenal surgery: Missing data (n=1,359 entries; 16,672 questions)



Adrenal surgery: Missing data (n=1,359 entries; 16,672 questions)





Summary

The extent of missing data for all endocrine case types is of some concern.

For thyroidectomy, even the most basic data that would allow simple calculation of complication rates are missing in over 10% of cases on average. Some data fields, potentially useful for more complex analyses such as for risk-adjustment of complication rates, are incomplete in a much higher proportion than this. Similar rates of missing data are also seen for parathyroid and adrenal cases.

There appears to be enormous variation between individual surgeons with respect to their rate of missing data. Some enthusiasts achieve well above average rates of data completeness, some at or close to 100% complete and these surgeons are to be congratulated. Others, however, have high rates of incomplete entries, occasionally close to zero percent.

This variation does not appear to be due to surgeon-volume, with many of the *highest volume surgeons* represented amongst the *enthusiasts*, despite the larger number of cases requiring data entry. *Audit fatigue* over time also does not appear to explain this divergence, as rates of incomplete data entry are stable over the last 5-6 years. However, data entry for outcomes at follow-up is less complete than for outcomes at discharge, reflecting the increased effort required to obtain these data and update the case entry.

This particular issue, and methods to improve data entry, should be debated amongst the membership. Methods may include:

- Open publishing of members' rates of complete data.
- Identification of those high-volume surgeons with high rates of complete data, with a view to sharing their methodology for successful and comprehensive data acquisition.
- Adding to the existing requirements for BAETS membership (entry of ≥ 30 cases per year) an additional need to achieve a given proportion of complete entries.
- Changes to the database, to prevent cases being logged until certain basic fields are complete.



Association

British



Surgery for thyroid disease



Surgery for thyroid disease

General information from the database

Number of members

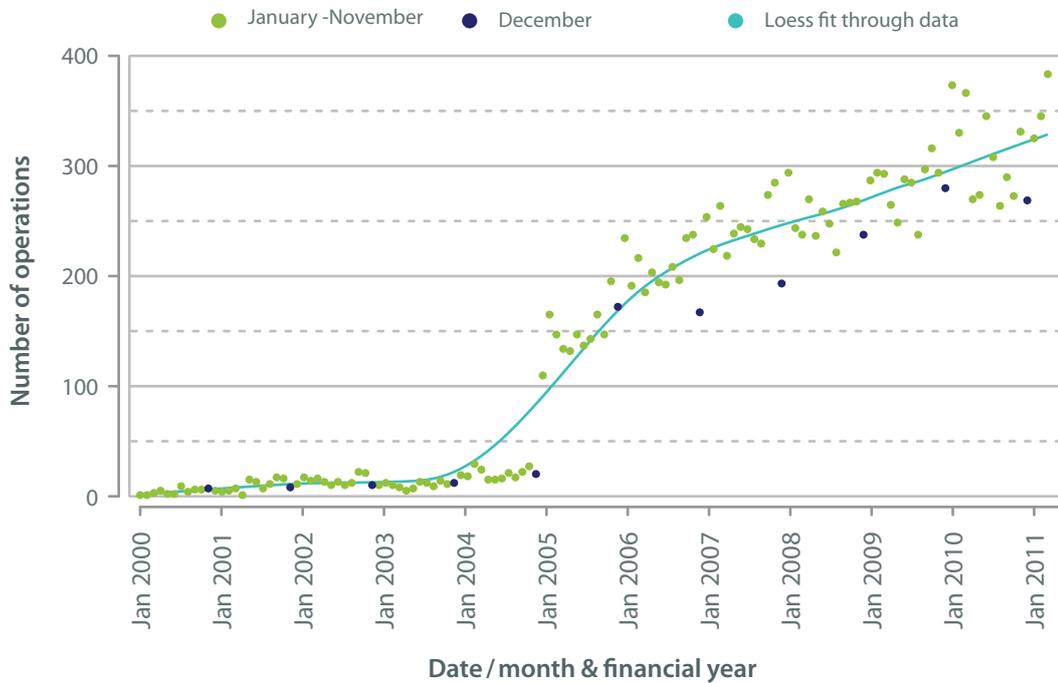
The rate of expansion of the database continues to increase, partly due to an increase in new membership, and partly due to increased / new participation from existing members. This latter may also reflect the stipulated requirement to enter at least 30 endocrine cases *per* year in order to remain an active member of the Association.

Fewer thyroid operations are performed in each December compared to the rest of the year, which is perhaps not surprising, given the reduction in operating time over the holiday period and the elective nature of thyroid surgery.

There are a total of 18,904 cases submitted by 142 members.

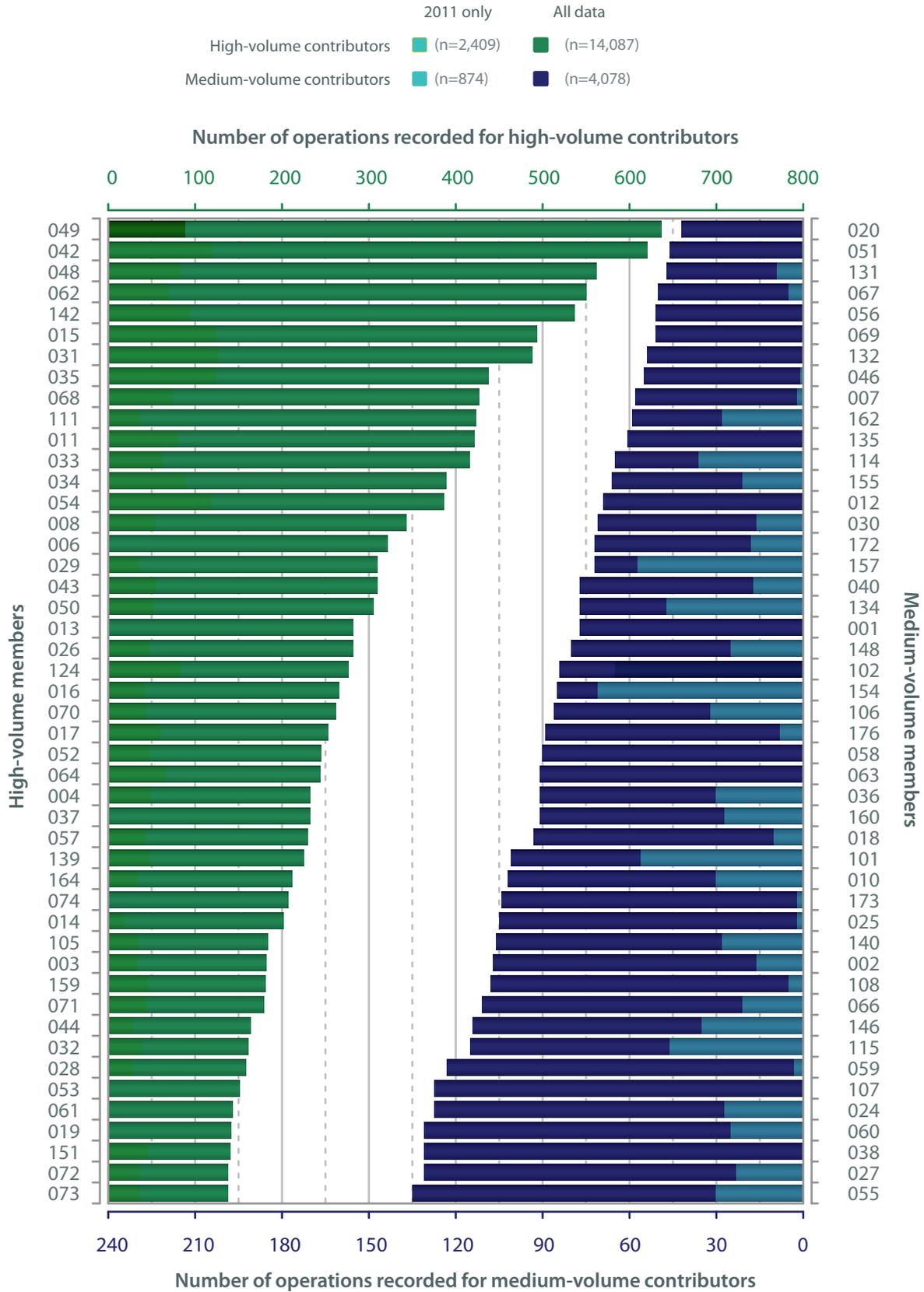
Surgery for thyroid disease

The growth of the database month by month (n=18,904 thyroid cases)





Thyroid surgery: Number of operations reported by each member



There are data from 48 lower-volume contributors not included in this chart, who submitted a total 739 cases (average = 15.4 cases per member).



Demographics and disease profile

Age

There has been no change in demographic profile over time. As expected, the majority of thyroid surgery is carried out on *middle aged* patients, and there is a strong female predominance (Female : Male ratio 4.58 : 1).

Basic age statistics according to gender

	Count	Average	Standard deviation	10 th percentile	Lower quartile	Median	Upper quartile	90 th percentile
Male	3,385	50.9	16.3	30.0	39.0	51.0	63.0	72.0
Female	15,513	48.0	15.7	28.0	37.0	47.0	59.0	70.0
All patients	18,898	48.5	15.9	28.0	37.0	48.0	60.0	70.0

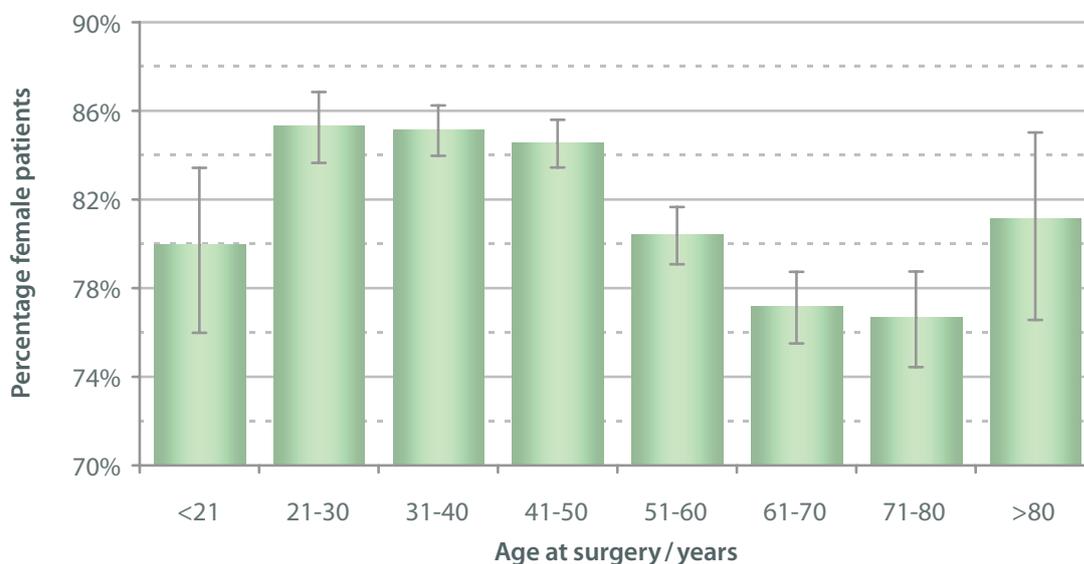


Age & gender

Thyroid surgery: age and gender distributions

		Gender				Proportion female
		Male	Female	Unspecified	All	
Age at surgery / years	<21	94	375	0	469	80.0%
	21-30	285	1,657	0	1,942	85.3%
	31-40	571	3,273	0	3,844	85.1%
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	51-60	726	2,978	0	3,704	80.4%
	61-70	606	2,047	0	2,653	77.2%
	71-80	355	1,166	0	1,521	76.7%
	>80	66	284	0	350	81.1%
	Unspecified	1	5	0	6	83.3%
	All	3,386	15,518	0	18,904	82.1%

Thyroid surgery: Age and gender (n=18,898)





Primary pathology

Primary pathology for all patients

Since October 2008 *primary pathology* has been identified separately to *secondary/incidental pathology*.

As expected, the majority of thyroid surgery is carried out for benign indications, particularly for Colloid / Multi-nodular Goitre and Graves' disease.

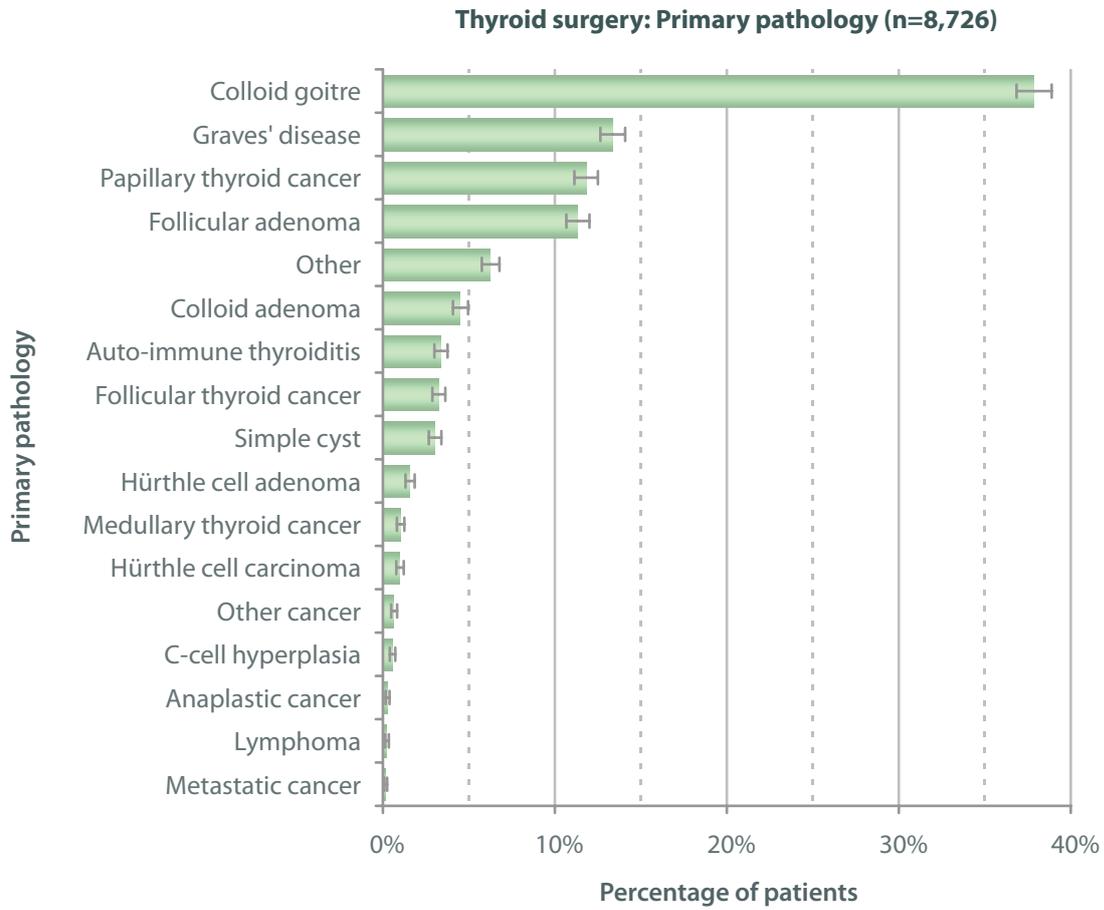
Of all operations, malignancy was the primary diagnosis in 15.6% of cases, while any neoplasia (including C-cell hyperplasia) accounted for 27.0%.

The rate of missing data for this field is 14.7%, representing a degree of improvement since the Third National Report in 2009, when the rate was 26.0%.

Surgery for thyroid disease

Thyroid surgery: primary pathology; data accumulated after the first revision of the registry

		Data	
		Count	Proportion
Primary pathology	Anaplastic cancer	22	0.3%
	Auto-immune thyroiditis	293	3.4%
	C-cell hyperplasia	47	0.5%
	Colloid adenoma	392	4.5%
	Colloid goitre	3,304	37.9%
	Follicular adenoma	988	11.3%
	Follicular thyroid cancer	282	3.2%
	Graves' disease	1,165	13.4%
	Hürthle cell adenoma	136	1.6%
	Hürthle cell carcinoma	85	1.0%
	Lymphoma	19	0.2%
	Metastatic cancer	12	0.1%
	Medullary thyroid cancer	88	1.0%
	Papillary thyroid cancer	1,030	11.8%
	Simple cyst	263	3.0%
	Other cancer	55	0.6%
	Other	545	6.2%
	Unspecified	1,498	
	All	10,224	



Surgery for thyroid disease



Cancer at first operation

Cancer and age

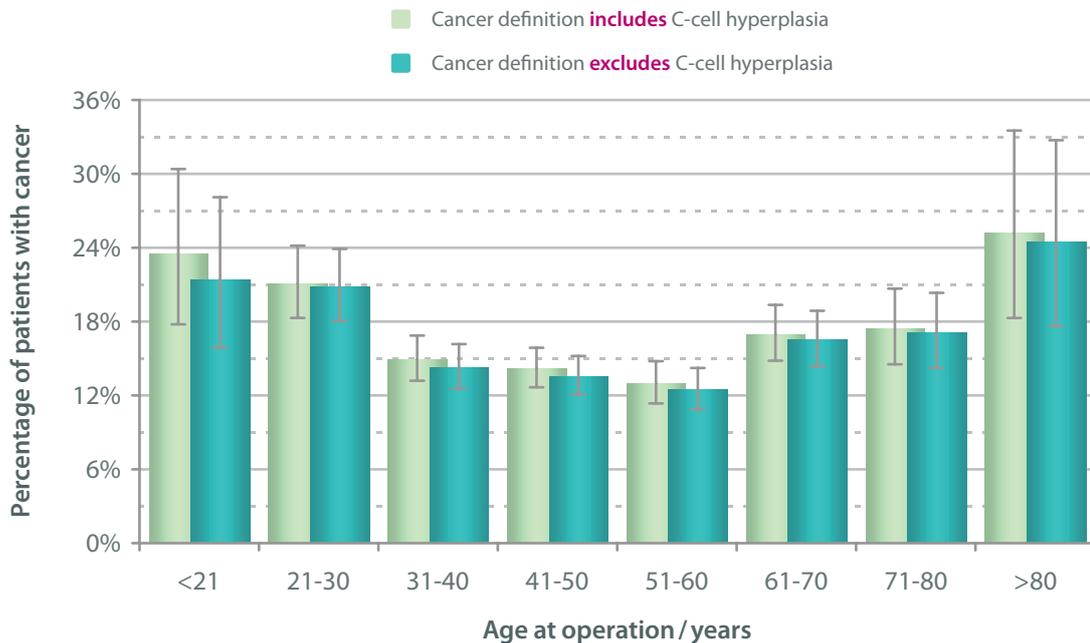
The incidence of thyroid cancer would be expected to follow a bimodal distribution, with peak frequency in children/adolescents and in individuals over 60 years of age. This distribution is more apparent in the present compared to the 2009 report.

First-time thyroid surgery: cancer at the time of the patient's operation and age; data accumulated after the first revision of the registry

Surgery for thyroid disease

		Cancer							
		C-cell hyperplasia included in the definition of cancer				C-cell hyperplasia excluded from the definition of cancer			
		No	Yes	Unspecified	Percentage	No	Yes	Unspecified	Percentage
Age at surgery / years	<21	143	44	19	23.5%	147	40	19	21.4%
	21-30	610	163	89	21.1%	612	161	89	20.8%
	31-40	1,281	225	153	14.9%	1,291	215	153	14.3%
	41-50	1,614	267	205	14.2%	1,626	255	205	13.6%
	51-60	1,335	199	152	13.0%	1,343	191	152	12.5%
	61-70	910	186	96	17.0%	915	181	96	16.5%
	71-80	508	107	52	17.4%	510	105	52	17.1%
	>80	101	34	12	25.2%	102	33	12	24.4%
	Unspecified	1	2	0	66.7%	2	1	0	33.3%
All	6,503	1,227	778	15.9%	6,548	1,182	778	15.3%	

First-time thyroid surgery: Cancer primary pathology rates and age (n=7,727)





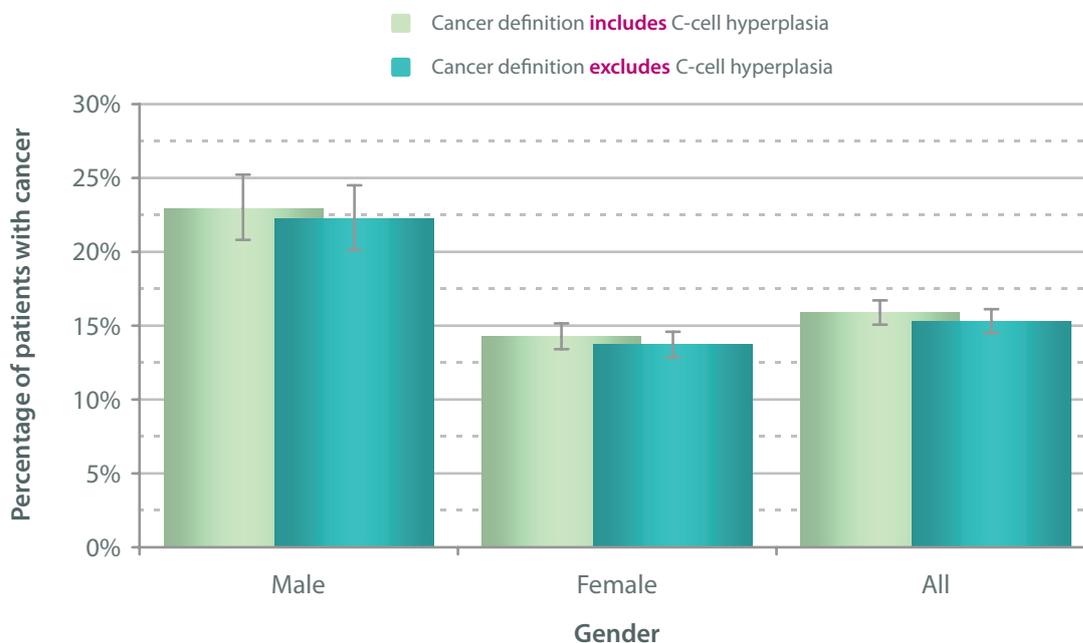
Cancer and gender

As seen in the 2009 report, the ratio of malignant : benign disease is higher in males than females, with over 1 in 5 thyroidectomies in men being performed for cancer. This is expected, given the much lower incidence of benign thyroid disease in males.

First-time thyroid surgery: cancer at the time of the patient's operation and gender; data accumulated after the first revision of the registry

		Cancer							
		C-cell hyperplasia included in the definition of cancer				C-cell hyperplasia excluded from the definition of cancer			
		No	Yes	Unspecified	Percentage	No	Yes	Unspecified	Percentage
Gender	Male	1,105	329	144	22.9%	1,115	319	144	22.2%
	Female	5,398	898	634	14.3%	5,433	863	634	13.7%
	Unspecified	0	0	0	NA	0	0	0	NA
	All	6,503	1,227	778	15.9%	6,548	1,182	778	15.3%

First-time thyroid surgery: Cancer primary pathology rates & gender (n=7,730)





Cancer and staging

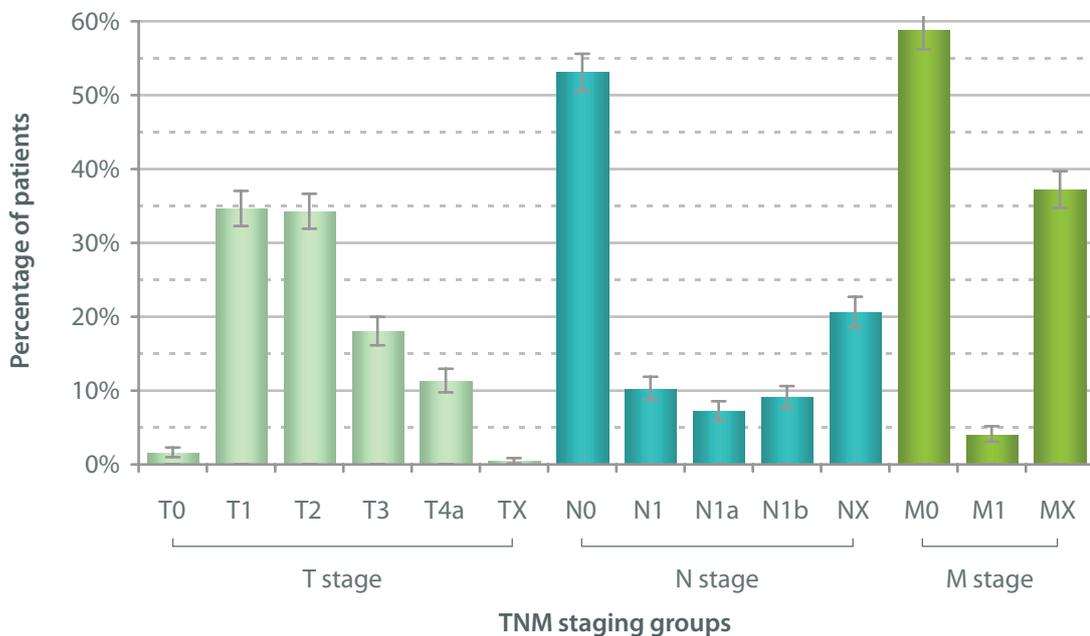
As detailed above (in the *Basic principles* section), there has been a change in the database, adopting TNM version 7 in preference to version 5, from November 2010.

As expected, overall cancer stage is I or II for the large majority of cases.

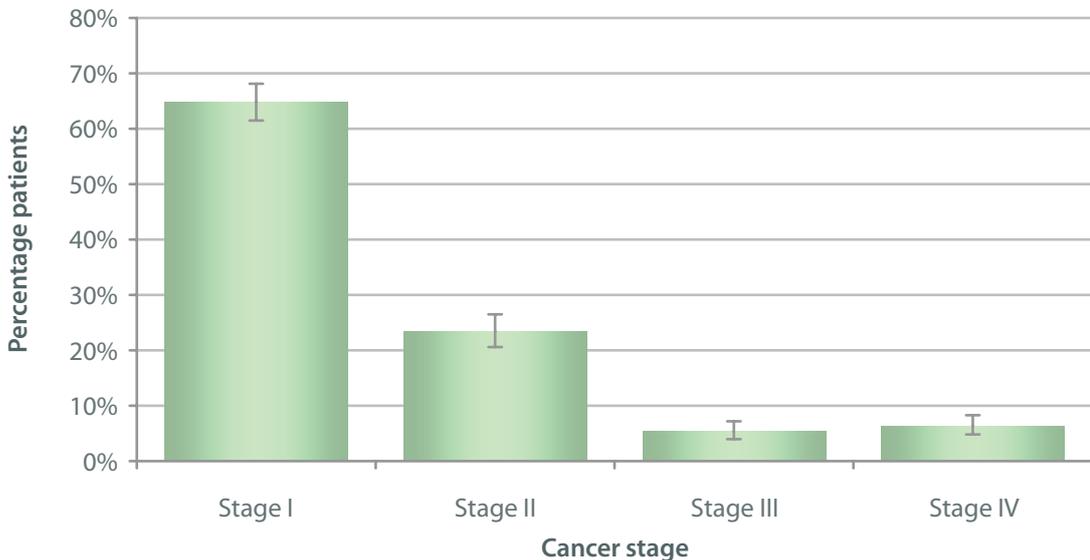
For N-stage the distribution of cases between N0 or NX categories may not be completely reliable, as 76% of those categorised as N0 did not undergo nodal dissection at the first operation, although a proportion of these may have proceeded to nodal surgery at a second operation and nodal status entered retrospectively.

Where the primary pathology is PTC and nodal dissection has been recorded, around 50% are N0, implying that these dissections were *prophylactic* in intent. Distinction between therapeutic and prophylactic intent is not possible for the cases recorded as N1.

First-time thyroid surgery: Cancer TNM staging



First-time thyroid surgery: Overall cancer stage (n=820)





Laterality of nodal surgery

When recorded, nodal dissection was not performed in over 50% of cases, again implying that a higher proportion of the cases allocated to N0 in the above graphs should technically be NX.

When nodal dissection was performed, it was bilateral in most cases, as expected because many were level 6 dissections (alone or in combination with other compartments).

First-time thyroid surgery for cancer where the side of the operation is known: node dissection; data accumulated after the first revision of the registry

		Node dissection: right			
		No	Yes	Unspecified	All
Node dissection: left	No	637	102	20	759
	Yes	75	312	2	389
	Unspecified	14	4	12	30
	All	726	418	34	1,178



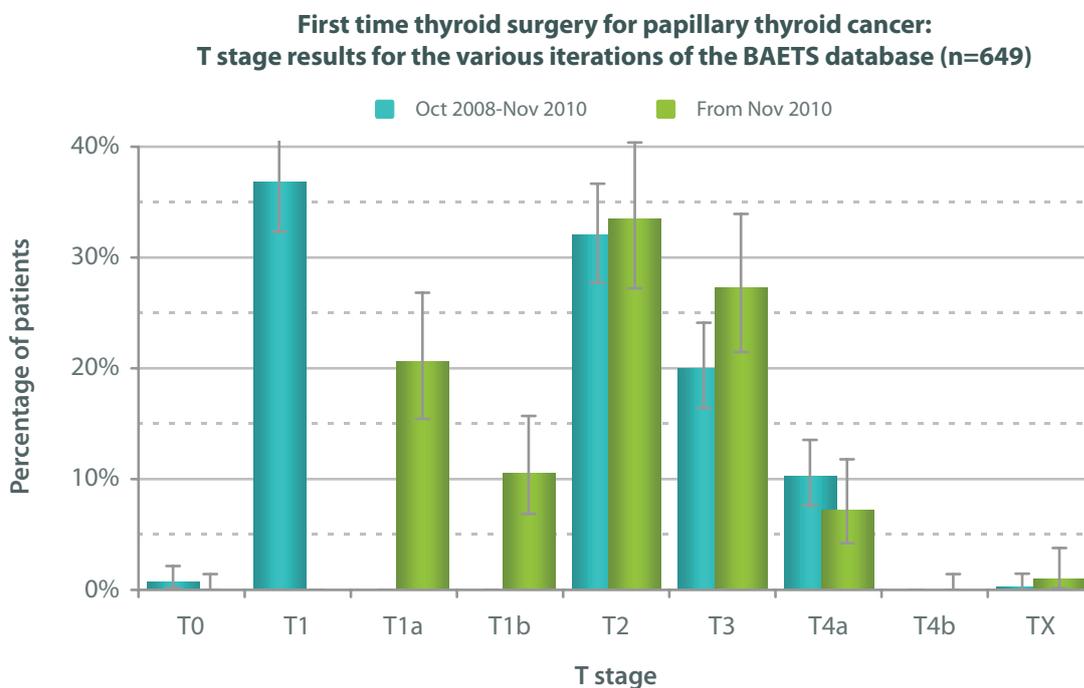
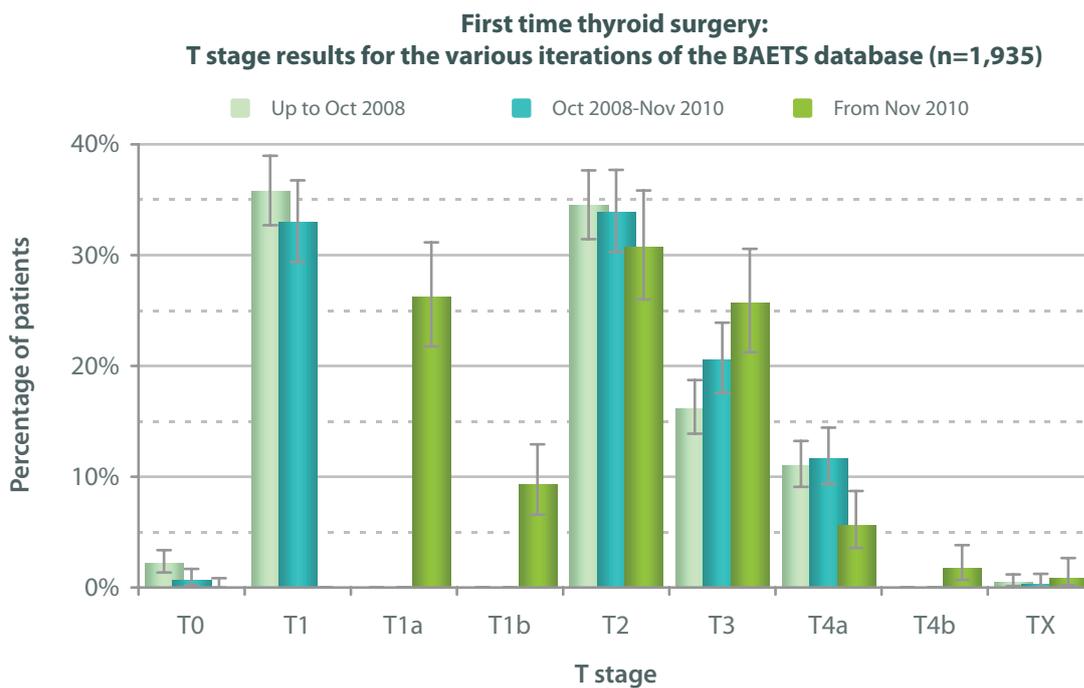
T stage

Overall T stage has been quite stable over time. A slight increase in T3 tumours at the expense of T4 is likely to represent the differences between TNM Versions 5 and 7 in assessing the degree of extra-thyroidal extension: in version 7 minimal extra-thyroidal disease is recorded as T3, whereas in version 5 any such extension represents T4.

There does not appear to have been a large increase in T1 tumours over the lifetime of the database. The data therefore do not suggest an increasing rate of cancer diagnoses secondary to detection of incidental micro-carcinomas. This will be easier to follow in future, as in TNM version 7, micro-carcinomas are represented by stage T1a. Since November 2010, these cases account for 26% of those where T-stage was recorded.

First-time thyroid surgery: T stage data

		Versions of the BAETS database					
		TNM version 5 Inception-Oct 2008		TNM version 5 Oct 2008 -Nov 2010		TNM version 7 Nov 2010-Date	
		Count	Percentage	Count	Percentage	Count	Percentage
T stage	T0	20	2.2%	4	0.6%	0	0.0%
	T1	332	35.8%	215	33.0%	NA	NA
	T1a	NA	NA	NA	NA	93	26.2%
	T1b	NA	NA	NA	NA	33	9.3%
	T2	320	34.5%	221	33.9%	109	30.7%
	T3	150	16.2%	134	20.6%	91	25.6%
	T4a	102	11.0%	76	11.7%	20	5.6%
	T4b	NA	NA	NA	NA	6	1.7%
	TX	4	0.4%	2	0.3%	3	0.8%
	Unspecified	6,683		5,225		2,276	
	All	7,611		5,877		2,631	



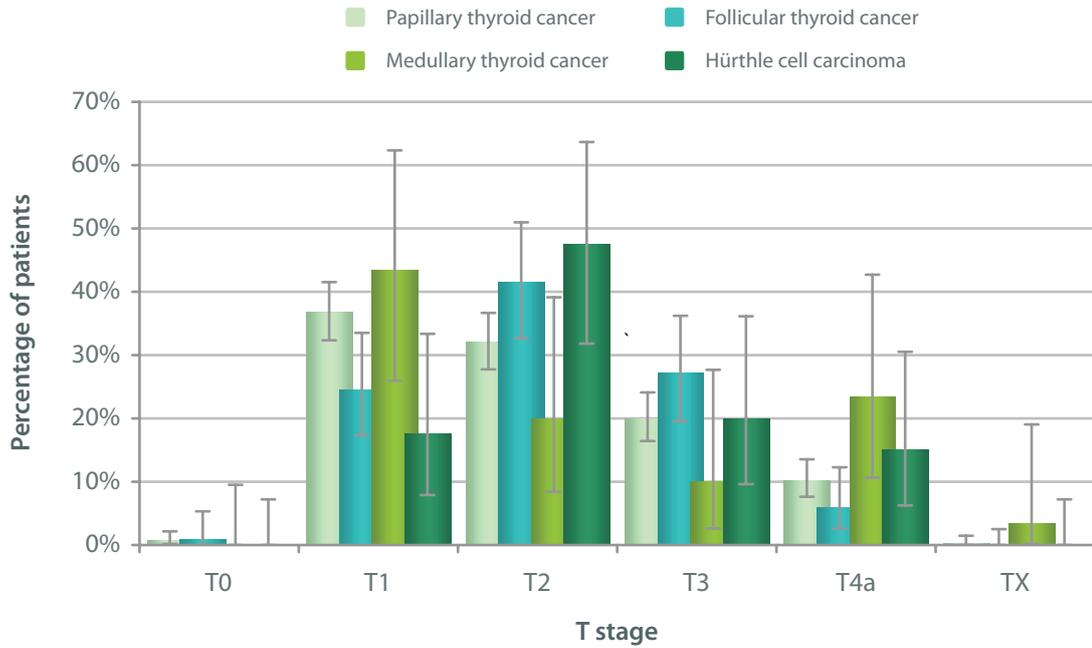


Amongst differentiated thyroid cancers, there is some evidence of a shift in T stage distribution towards more advanced disease in the order Hürthle cell carcinoma > follicular thyroid cancer > papillary thyroid cancer. This is consistent with the known biology of these diseases.

Likewise, the higher incidence of locally advanced disease (T4a) with medullary carcinoma is perhaps not surprising.

Surgery for thyroid disease

First-time thyroid surgery:
T stage results for selected primary pathologies (n=628)

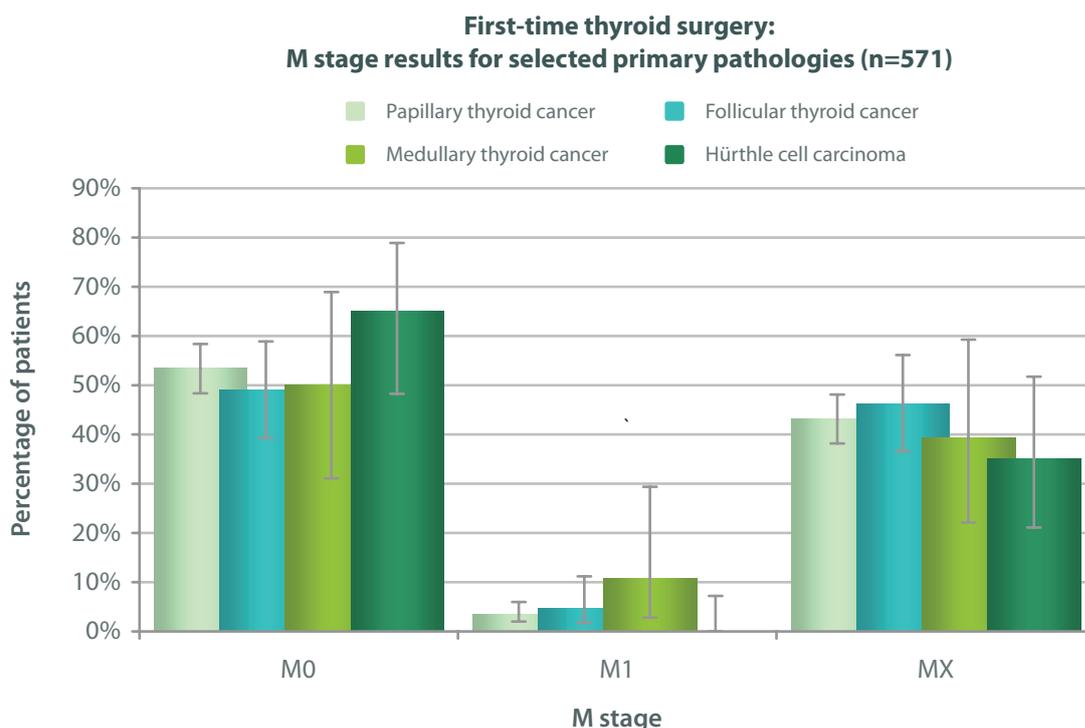
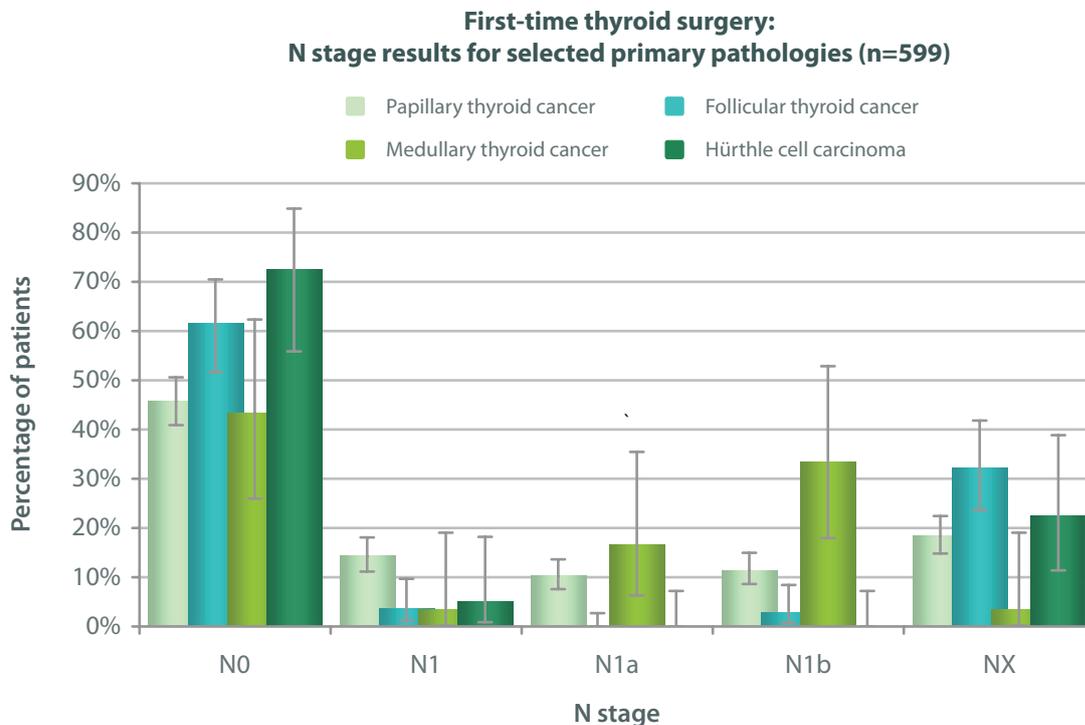




N and M Stage

Most Follicular and Hürthle-cell carcinomas are recorded as N0 or NX, reflecting the low rate of node dissection performed for these pathologies. More extensive nodal involvement is recorded for medullary than for papillary cancer, perhaps reflecting both cancer biology and the relative frequency of prophylactic nodal surgery performed for these types of malignancy.

A higher proportion of medullary cancer is recorded as M1 stage at the time of primary surgery.





Surgery for thyrotoxicosis

Thyroid status and operation

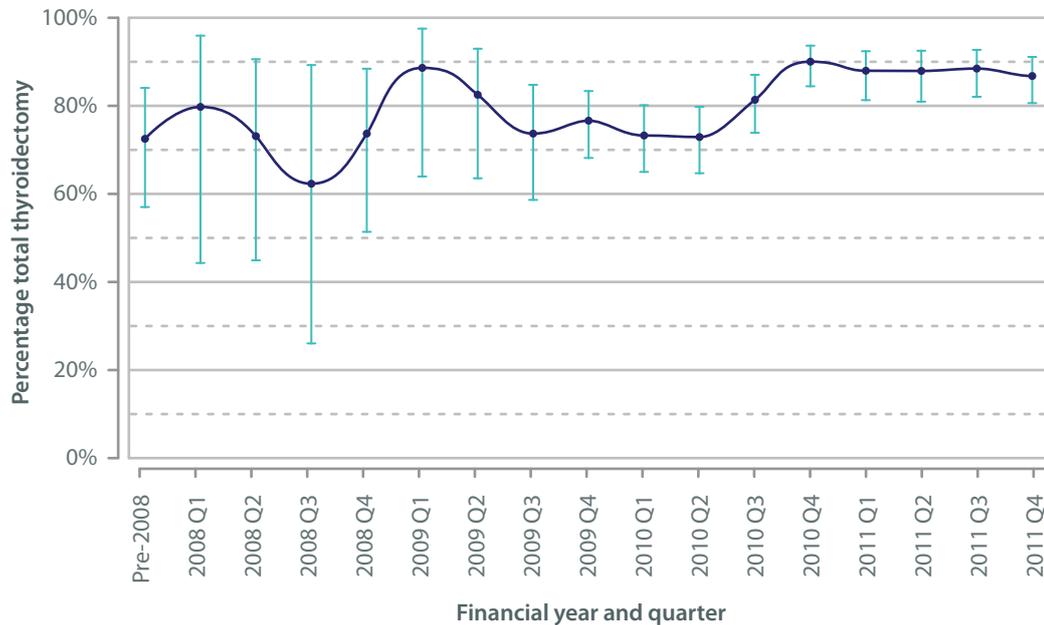
There has been an increasing trend away from the traditional bilateral subtotal thyroidectomy for treating thyrotoxicosis, in favour of total/near-total resection. Where thyrotoxicosis is the indication for surgery, total thyroidectomy is currently performed in almost 90% of cases.

Thyroid surgery for thyrotoxicosis: thyroid status at presentation and operation performed; data accumulated after the first revision of the registry

		Operation			
		Less than total thyroidectomy	Total thyroidectomy	Unspecified	Rate of total thyroidectomy
Thyroid status	Euthyroid	63	287	49	82.0%
	Hyperthyroid	187	893	59	82.7%
	Hypothyroid	2	5	0	71.4%
	Unspecified	2	9	16	81.8%
	All	254	1,194	124	82.5%

Surgery for thyroid disease

**Thyroid surgery for thyrotoxicosis:
Total thyroidectomy rates over time (n=1,448)**

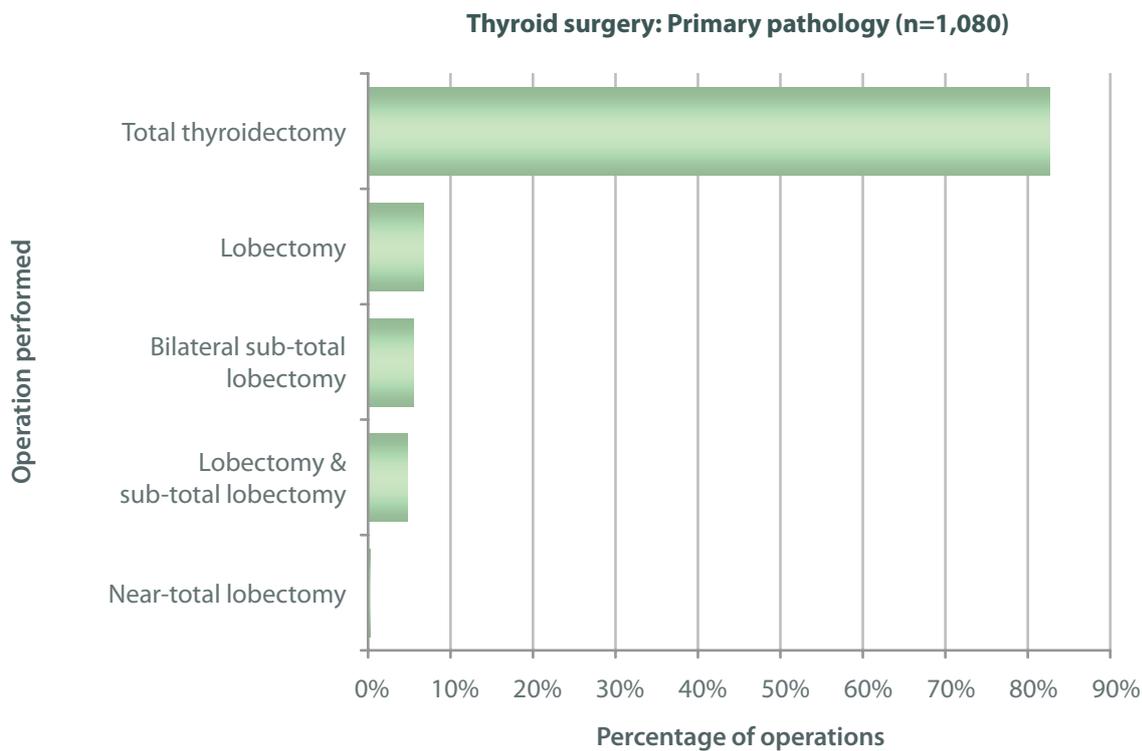




Hyperthyroidism and operation

Thyroid surgery for patients with hyperthyroidism whose indication for surgery was thyrotoxicosis: operation performed; data accumulated after the first revision of the registry

		Data	
		Count	Proportion
Operation performed	Total thyroidectomy	893	82.7%
	Lobectomy & sub-total thyroidectomy	51	4.7%
	Lobectomy	73	6.8%
	Bilateral sub-total lobectomy	60	5.6%
	Near-total lobectomy	3	0.3%
	Unspecified	59	
All		1,139	





Surgery for euthyroid / hypothyroid patients

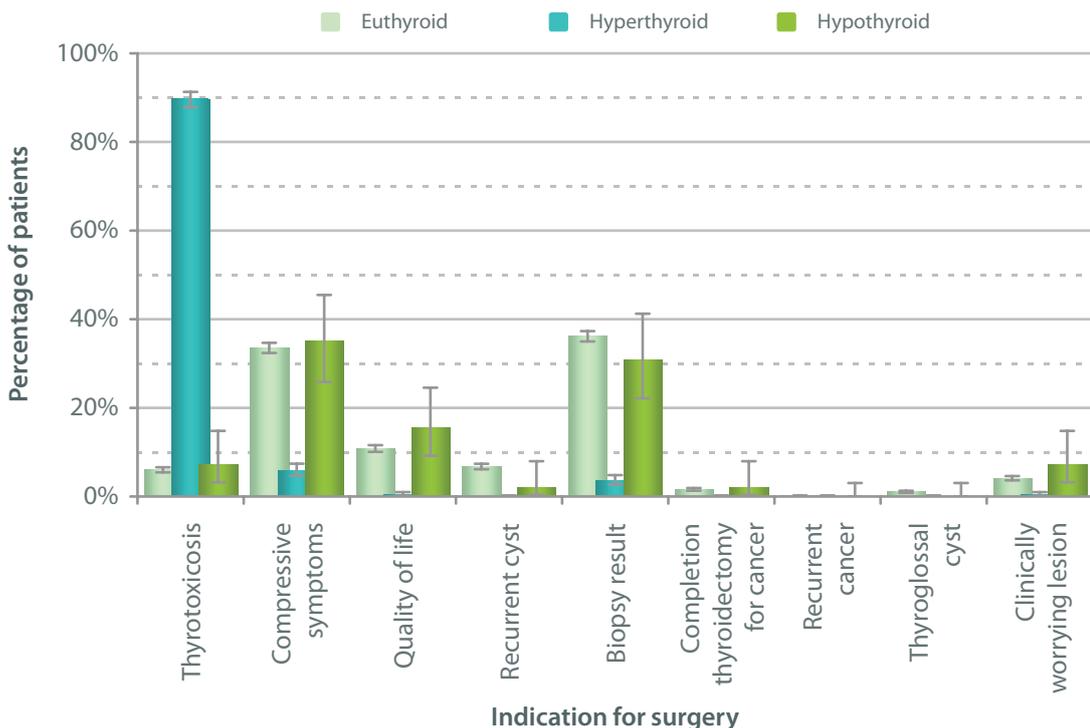
For euthyroid patients, the commonest indications for surgery are biopsy result (36%), compressive symptoms (34%) and quality of life (11%). *Clinically worrying lesion* is a relatively new field, but accounts for an increasing proportion of cases since its introduction in 2010 (in 2011, accounting for 11% of cases in the database where the indication is recorded). A similar distribution is seen for those patients who were hypothyroid pre-operatively.

Those 393 cases with euthyroid pre-operative status who underwent surgery for thyrotoxicosis probably represent cases who were thyrotoxic at presentation, but where euthyroid pre-operative status has been entered, due to control of toxicosis by medical therapy in preparation for surgery. Goitre type (*retro-sternal versus cervical*) is also a relatively new data field, but despite this it is clear that the predominant indication for surgery in retro-sternal goitre is compressive symptoms (74% compared to 20% for cervical goitre).

First-time thyroid surgery: indication for surgery and thyroid status; data accumulated after the first revision of the registry

		Thyroid status			
		Euthyroid	Hyperthyroid	Hypothyroid	Unspecified
Indication	Thyrotoxicosis	393	1,123	7	24
	Compressive symptoms	2,199	74	34	27
	Quality of life	709	5	15	13
	Recurrent cyst	442	0	2	9
	Biopsy result	2,371	45	30	33
	Completion thyroidectomy for cancer	103	0	2	0
	Recurrent cancer	7	0	0	0
	Thyroglossal cyst	67	0	0	4
	Clinically worrying lesion	269	5	7	1
	Unspecified	413	37	12	26

First-time thyroid surgery: Indication for surgery and thyroid status (n=7,628)

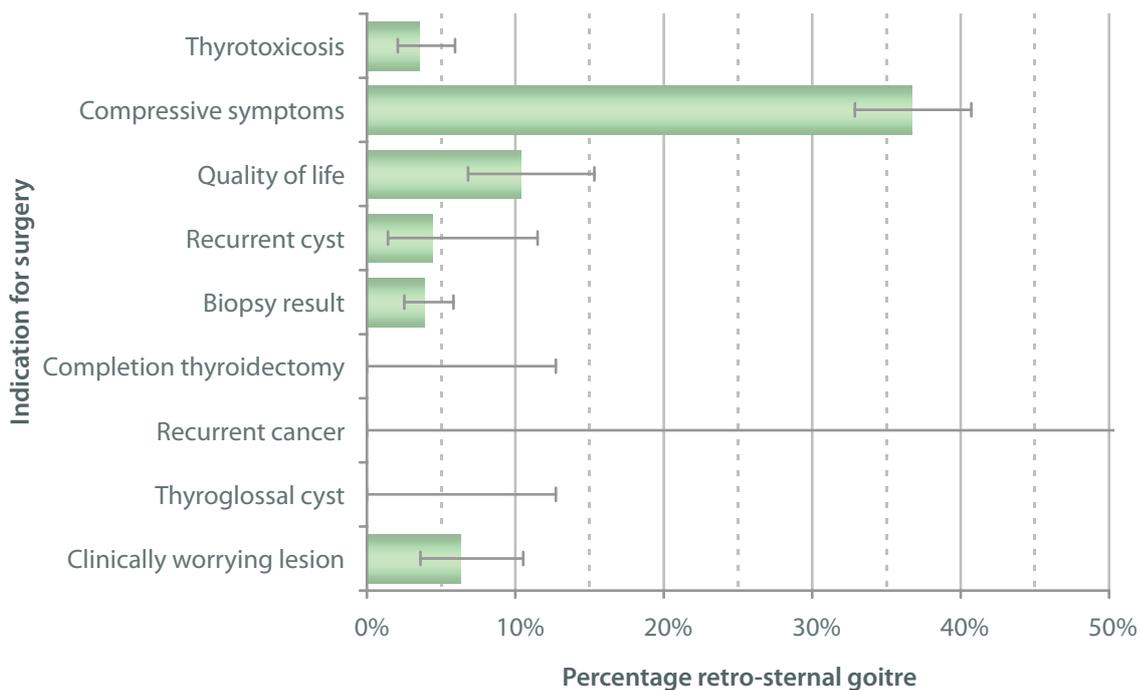




First-time thyroid surgery: indication for surgery and goitre type; data accumulated after the second revision of the registry

		Goitre			
		Cervical	Retro-sternal	Unspecified	All
Indication	Thyrotoxicosis	406	15	69	490
	Compressive symptoms	381	221	48	650
	Quality of life	199	23	120	342
	Recurrent cyst	87	4	8	99
	Biopsy result	572	23	47	642
	Completion thyroidectomy for cancer	22	0	3	25
	Recurrent cancer	1	0	1	2
	Thyroglossal cyst	22	0	9	31
	Clinically worrying lesion	209	14	52	275
	Unspecified	35	5	35	75
	All	1,934	305	392	2,631

First-time thyroid surgery: Indication for surgery in relation to goitre type (cervical or retrosternal; n=2,199)





Investigations

Pre-operative laryngoscopy for first time operations

Over the life of the database, 60.9% of patients were recorded as undergoing a pre-operative laryngoscopy before a first-time operation. The rates in the last three financial years (2009, 2010, 2011) were 61.9%, 55.5% and 57.7% respectively.

A greater proportion of patients with thyroid cancer underwent laryngoscopy compared to the patients with benign disease (57.9% versus 64.7%; $p < .0001$).

Pre-operative laryngoscopy for re-operative cases

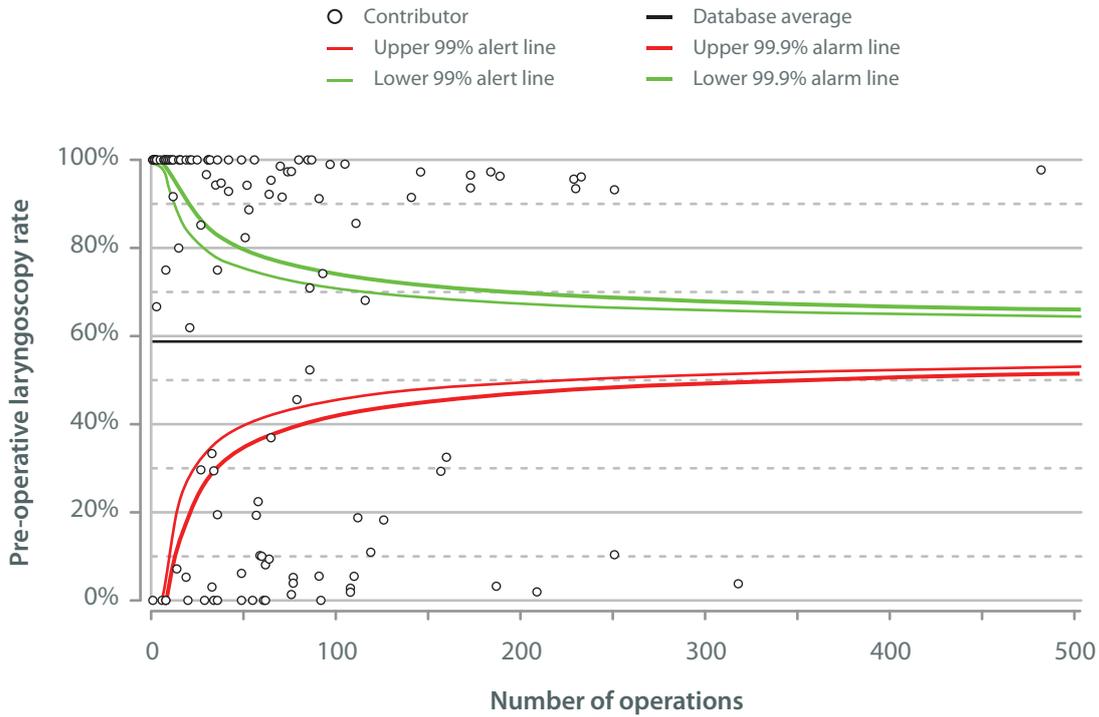
For operations on the same side as the previous procedure, the pre-operative laryngoscopy rate is 86.7% (202 / 233 entries; no unknowns).

It seems clear that there is no consensus on the use of laryngoscopy pre-operatively, with variation in practice between 0% and 100% for first-time surgery.

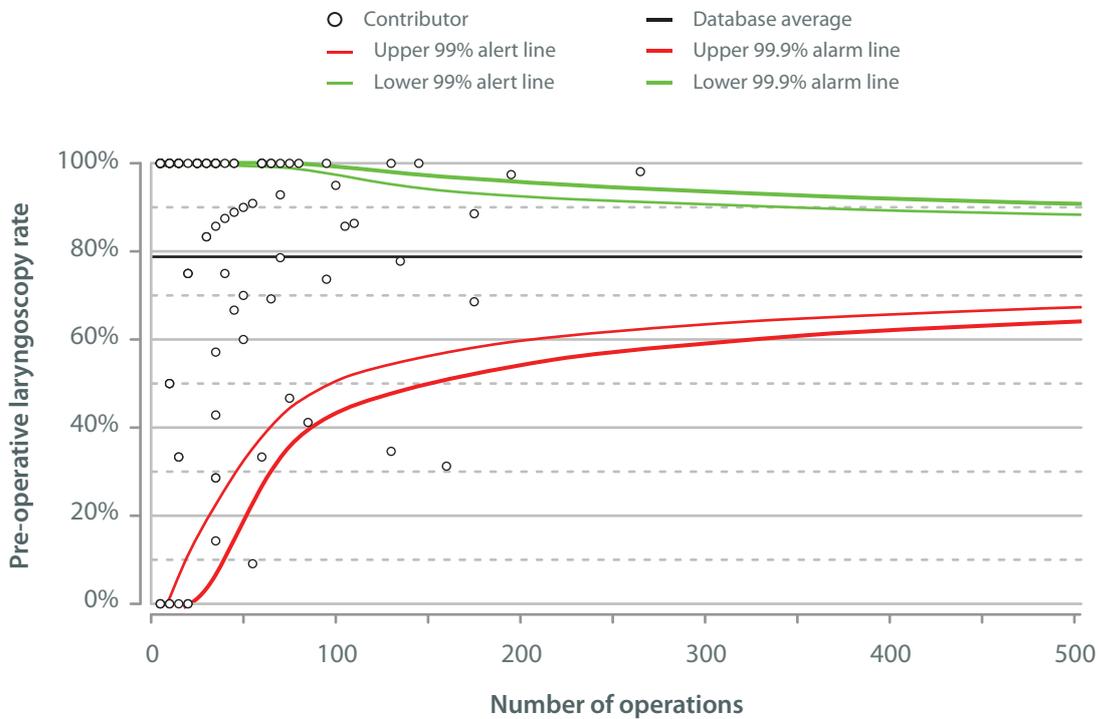
It remains of concern that this variation also exists for re-operative thyroid surgery, despite BAETS guidelines suggesting universal usage in such cases, and this issue having been raised in previous audit reports.



First-time thyroid surgery: Pre-operative laryngoscopy rates (n=8,378)



Re-operative surgery thyroid surgery: Pre-operative laryngoscopy rates (n=953)





Fine Needle Aspiration Cytology (FNAC)

Overall use of FNAC has changed little since the Third Report in 2009. For all neoplasms undergoing surgery FNAC was utilised in 2,204 / 2,685 = 82.1% (compared to 81.8% in 2009), and for cancer the rate was 1,169 / 1,569 = 74.5% (73.9% in 2009).

However, upon analysis of the indication for surgery in cancer cases, it is apparent that for papillary and follicular cancer cases where no pre-operative FNAC was undertaken, around 59% were completion lobectomies, implying that the cancer diagnosis had been made at a previous procedure. For first-time thyroidectomy, the rate of FNAC usage becomes 86% for both these cancer subtypes. For other cases the diagnosis may also have been made by wide bore core needle biopsy of a lymph node. Overall, therefore, the results suggest that FNAC is being used appropriately.

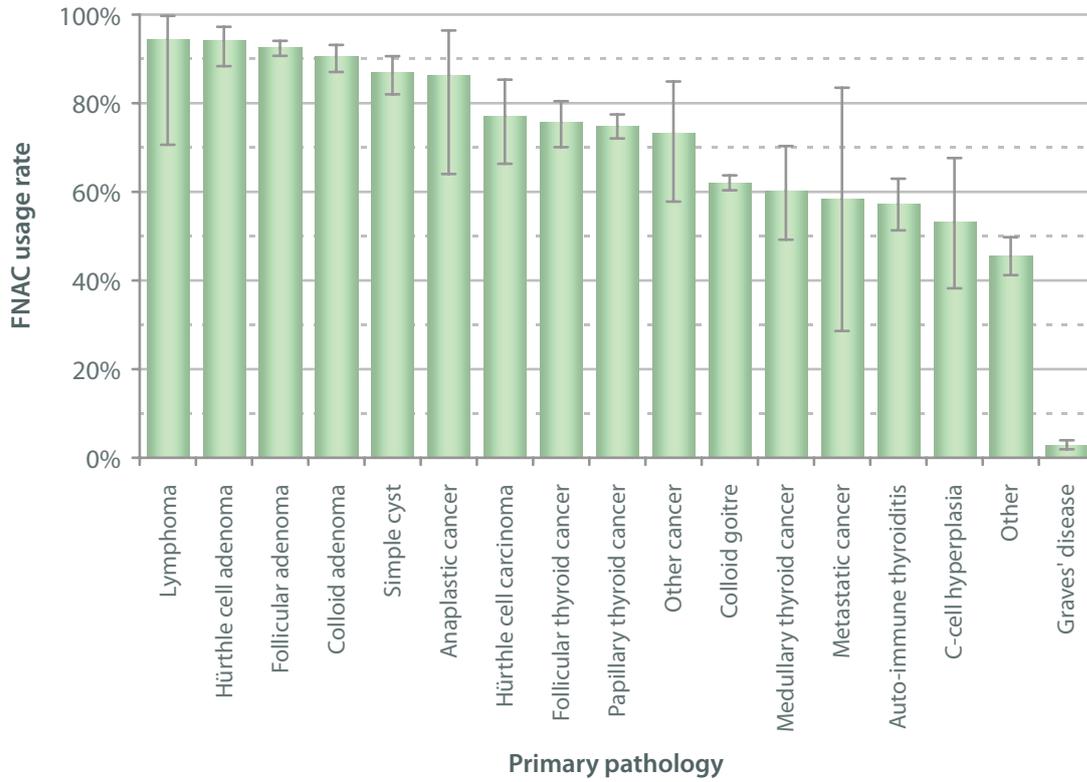
In contrast, for medullary cancers not undergoing FNAC the main indications for surgery are biopsy result and recurrence: presumably most of these are diagnosed by means other than FNAC, perhaps wide-bore needle biopsy (not recorded in this audit).

Thyroid surgery: primary pathology and the use of FNAC; data accumulated after the first revision of the registry

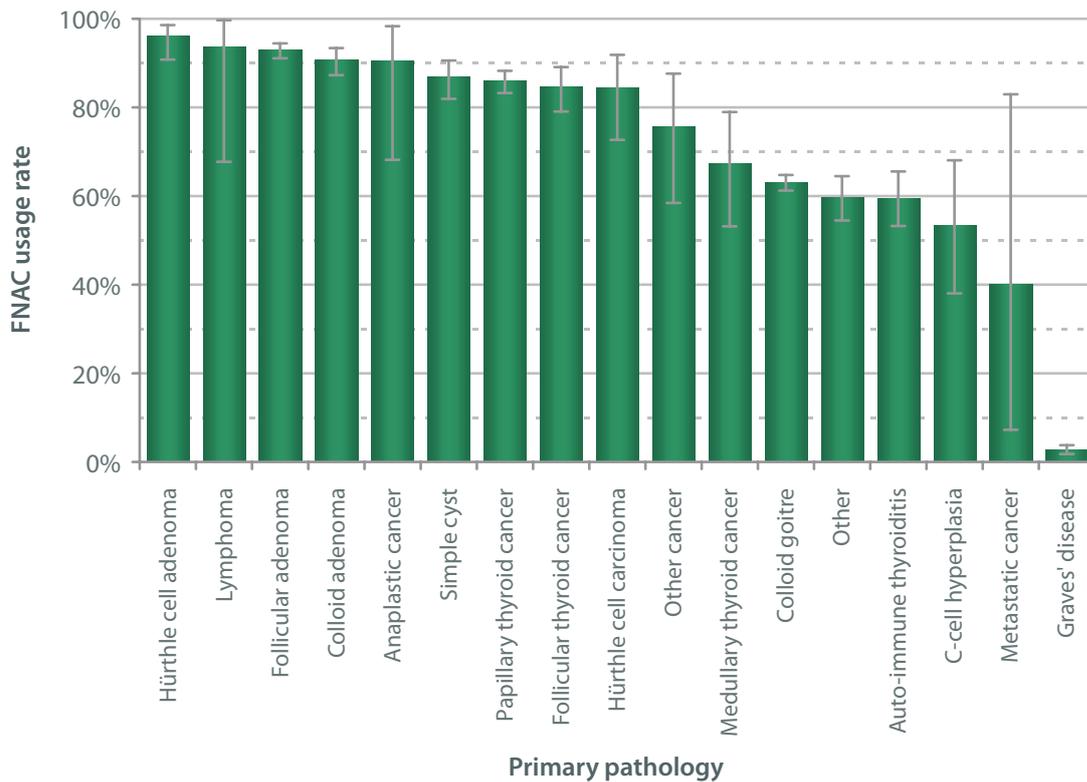
	FNAC usage				
	No	Yes	Unspecified	All	Rate
Anaplastic cancer	3	19	0	22	86.4%
Auto-immune thyroiditis	124	166	3	293	57.2%
C-cell hyperplasia	22	25	0	47	53.2%
Colloid adenoma	37	353	2	392	90.5%
Colloid goitre	1,235	2,020	49	3,304	62.1%
Follicular adenoma	73	907	8	988	92.6%
Follicular thyroid cancer	68	211	3	282	75.6%
Graves' disease	1,090	31	44	1,165	2.8%
Hürthle cell adenoma	8	128	0	136	94.1%
Hürthle cell carcinoma	19	64	2	85	77.1%
Lymphoma	1	17	1	19	94.4%
Metastatic cancer	5	7	0	12	58.3%
Medullary thyroid cancer	35	53	0	88	60.2%
Papillary thyroid cancer	257	765	8	1,030	74.9%
Simple cyst	34	225	4	263	86.9%
Other cancer	12	33	10	55	73.3%
Other	294	245	6	545	45.5%
Unspecified	317	546	635	1,498	63.2%
All	3,634	5,815	775	10,224	61.5%



Thyroid surgery: FNAC use and primary pathology (n=8,586)



First time thyroid surgery: FNAC use and primary pathology (n=7,681)





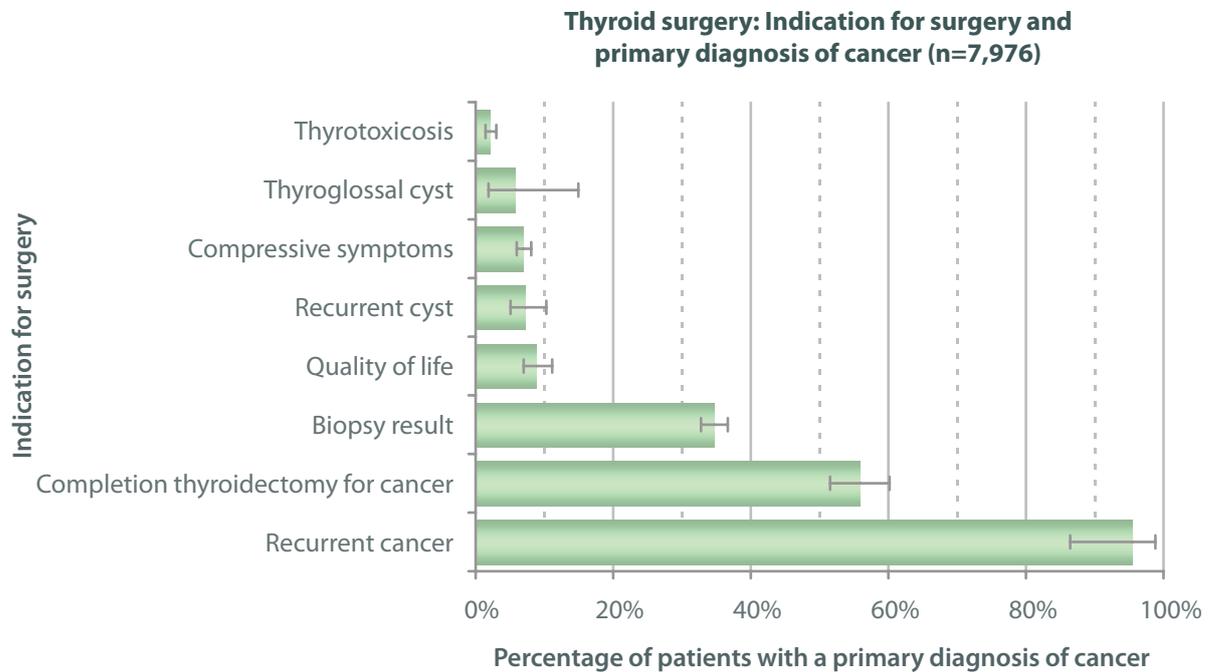
Cancer and indication for surgery

The data relating cancer diagnosis to indication for surgery are very similar to those in the 2009 report. There is a small, but significant, risk of a primary cancer diagnosis in recurrent cysts, thyroglossal cysts and patients with compressive symptoms.

Thyroid surgery: indication for surgery and primary diagnosis of cancer¹; data accumulated after the first revision of the registry

Surgery for thyroid disease

Indication for surgery	Primary diagnosis of cancer			
	No	Yes	Unspecified	Rate
Thyrotoxicosis	1,407	30	135	2.1%
Compressive symptoms	2,182	163	228	7.0%
Quality of life	701	68	15	8.8%
Recurrent cyst	395	31	36	7.3%
Biopsy result	1,527	811	279	34.7%
Completion thyroidectomy for cancer	232	294	57	55.9%
Recurrent cancer	3	63	4	95.5%
Thyroglossal cyst	65	4	4	5.8%
Unspecified	593	157	740	20.9%
All	7,105	1,621	1,498	18.6%



1. C-cell hyperplasia included.





FNAC result and pathology

The distribution of FNAC results by primary diagnosis is similar to the 2009 report.

As expected, the commonest FNAC result for follicular (including Hürthle cell) neoplasms was C3.

In those cases undergoing surgery where an FNAC was performed, a C3-5 result was obtained in:

- 81% of papillary cancers.
- 76% of follicular cancers.
- 94% of medullary cancers.

However, a definitive C5 result was obtained in only:

- 34% of papillary cancers
- 55% of medullary cancers

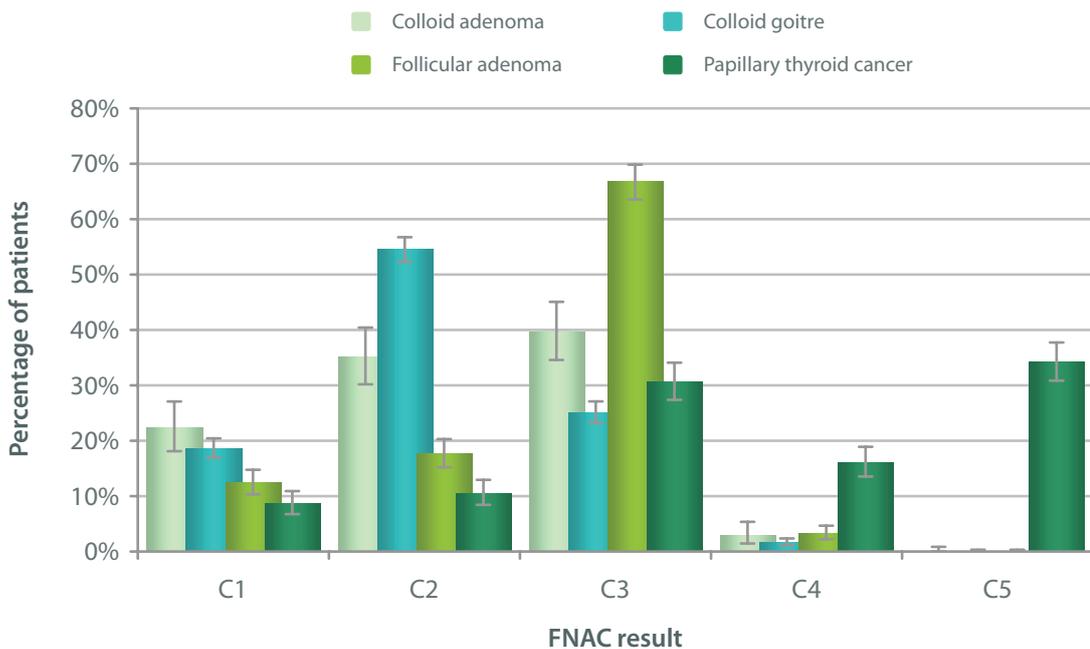
The C1 (*inadequate*) rate overall is stable over time (16.4% of operated patients, compared to 16.9% in 2009 report), but is lower in cancer cases (8.8%).

Amongst operated cancer cases, a C2 FNAC was obtained in 10.6%, implying other indications for surgery existed.

Excluding C-cell hyperplasia cases, the rates of cancer diagnoses amongst the 5 FNAC categories (where recorded) were:

- C5 = 98.2% (329/335)
- C4 = 63.4% (184/290)
- C3 = 21.5% (416/1,933)
- C3 (all neoplasia) = 57.0% (1,102/1,933)
- C2 = 7.1% (122/1,714)
- C1 = 11.5% (101/880)

Thyroid surgery patients investigated by FNAC: FNAC results for selected primary pathologies (n=3,976)





These figures are remarkably close to the malignancy risk estimates for thyroid cytology categories quoted by the Royal College of Pathologists' latest guidelines (Royal College of Pathologists Guideline G089: Guidance on the reporting of thyroid cytology specimens 2009; available at www.rcpath.org). It should be noted, however, that they do not equate to the true positive / negative predictive values of each category, as non-operated cases are not included in the audit.

The C3-5 rate for auto-immune thyroiditis remains higher than for colloid goitre (59.1% versus 26.8%, $p < 0.001$), potentially leading to unnecessary surgery.

Thyroid surgery: primary pathology and FNAC result for patients whose disease was investigated by FNAC; data accumulated after the first revision of the registry

		FNAC result ¹						All
		C1	C2	C3	C4	C5	Unspecified	
Primary pathology	Anaplastic cancer	2	1	1	4	11	0	19
	Auto-immune thyroiditis	22	45	85	12	0	2	166
	C-cell hyperplasia	3	9	12	0	1	0	25
	Colloid adenoma	78	123	139	10	0	3	353
	Colloid goitre	368	1,077	496	33	1	45	2,020
	Follicular adenoma	111	158	599	29	0	10	907
	Follicular thyroid cancer	25	26	123	27	9	1	211
	Graves' disease	6	8	16	0	0	1	31
	Hürthle cell adenoma	10	16	87	11	1	3	128
	Hürthle cell carcinoma	2	7	39	11	5	0	64
	Lymphoma	2	4	4	4	3	0	17
	Metastatic cancer	1	0	1	2	3	0	7
	Medullary thyroid cancer	2	1	11	8	27	4	53
	Papillary thyroid cancer	65	79	231	121	258	11	765
	Simple cyst	131	72	12	0	1	9	225
	Other cancer	2	4	6	7	13	1	33
	Other	53	93	83	11	3	2	245
	Unspecified	49	155	249	31	30	32	546
All	932	1,878	2,194	321	366	124	5,815	

- FNAC results are defined as:
 - Non-diagnostic.
 - Non-neoplastic.
 - Follicular lesions / neoplasia cannot be excluded.
 - Abnormal; suspicious of malignancy.
 - Malignant.



Multi-disciplinary team (MDT) meeting

There are a number of pathways by which cases may be referred for discussion at the Thyroid Cancer MDT, either prior to and /or following thyroid surgery. These are summarised for the majority of cases in the following flow diagram opposite.

Where there is a final diagnosis of cancer, it is reassuring to note that post-operative discussion at an MDT is practically universal (first-time surgery: 98.6%; n=1,033; 95% CI: 97.7-99.2%; all surgery for cancer: 98.7%; n=1,367; 95% CI: 97.9-99.2%).

However, MDT discussion prior to surgery occurs in only about half of cases with a final primary diagnosis of cancer. It would seem that this much lower rate of MDT referral is predominantly due to the limitations of non-operative (FNAC) diagnosis.

National (BTA) guidelines suggest that all C5 aspirates are discussed at the MDT to ratify an appropriate course of action prior to surgery being undertaken. The fact that only 82% of those cancers having C5 FNAC were discussed pre-operatively at the MDT is therefore of some concern.

Guidelines are not prescriptive regarding pre-operative MDT discussion for C3-4 aspirates, but given the influence of such pre-operative discussion on primary total thyroidectomy rates for cancer, detailed later in this report, it is possible that a stronger case could be made for this to occur.

The apparent relatively low rate of MDT discussion prior to completion thyroidectomy for cancer may be a true reflection of such discussion or a problem with the terminology of this data field (as it refers to MDT discussion prior to the first operation, which might be taken to mean the previous diagnostic procedure).

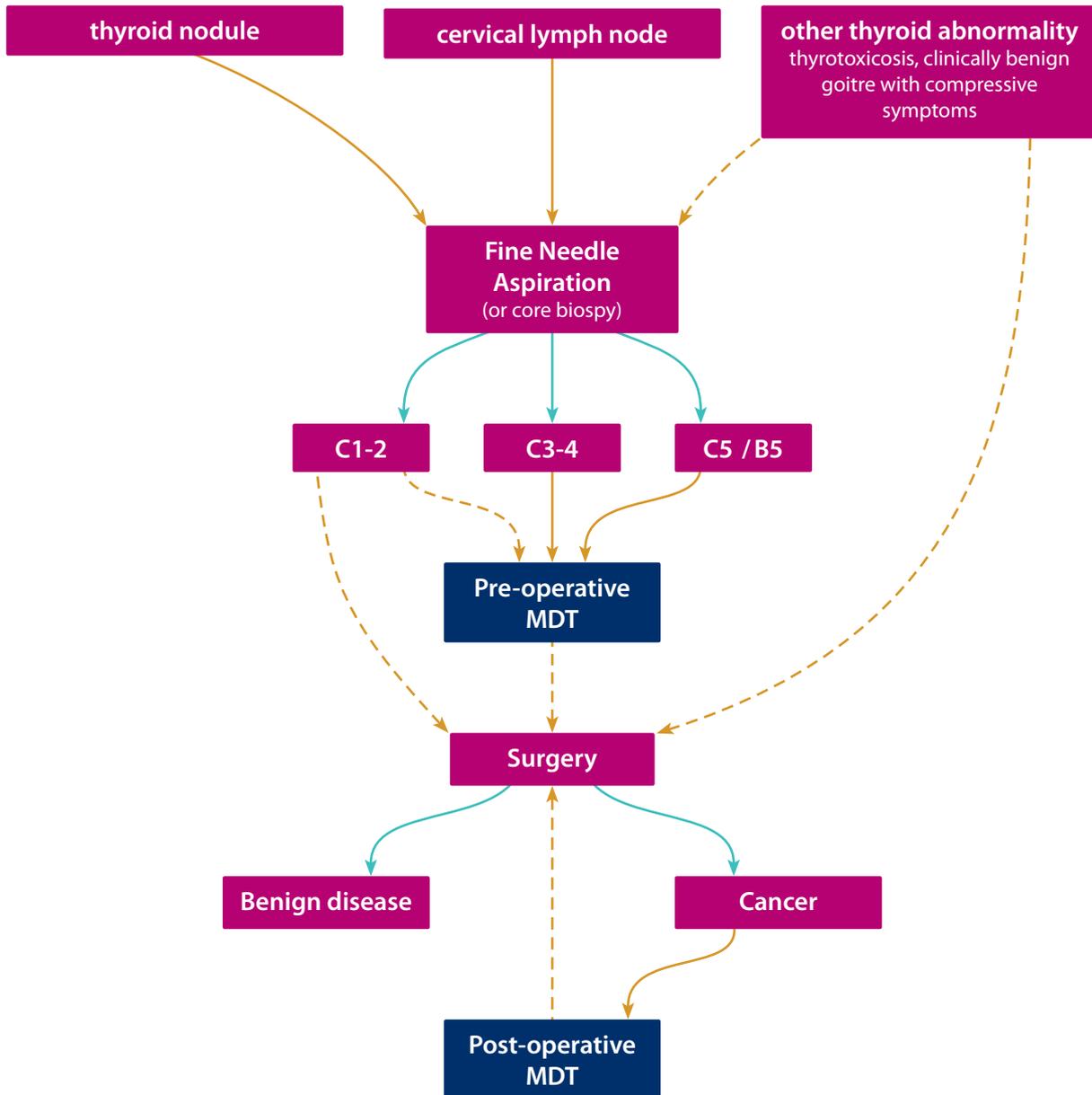
Thyroid surgery for patients with cancer: pre-operative MDT discussion and FNAC results & selected indications for surgery; data accumulated after the first revision of the registry

		Pre-operative MDT				
		No	Yes	Unspecified	Rate (95% CI)	
Pre-operative factor	FNAC for patients with cancer	No FNAC	167	169	85	50.3% (44.8-55.8%)
		FNAC result C1	65	22	15	25.3% (16.8-35.9%)
		FNAC result C2	85	14	28	14.1% (8.2-22.9%)
		FNAC result C3	227	149	48	39.6% (34.7-44.8%)
		FNAC result C4	55	103	22	65.2% (57.2-72.5%)
		FNAC result C5	52	232	43	81.7% (76.6-85.9%)
		FNAC result unspecified	4	9	4	69.2% (38.9-89.6%)
		All investigated via FNAC	488	529	160	52.0% (48.9-55.1%)
		Unspecified	5	5	13	50.0% (20.1-79.9%)
		All patients with cancer	660	703	258	51.6% (48.9-54.3%)
Indication	Biopsy result	293	416	102	58.7% (54.9-62.3%)	
	Completion thyroidectomy	106	156	32	59.5% (53.3-65.5%)	
	Recurrent cancer	4	40	19	90.9% (77.4-97.0%)	
	Clinically worrying lesion	39	27	6	40.9% (29.2-53.7%)	
	All patients with cancer	660	703	258	51.6% (48.9-54.3%)	



Flow diagram illustrating potential routes of referral to Thyroid Cancer MDT pre- and post-operatively

- Recommended or most frequent route
- - - → Alternative or potential outcomes
- Result of investigation or surgery





Operation

All operations

Operations for thyroid cancer

The large majority of patients with a primary cancer diagnosis undergo either lobectomy or total thyroidectomy. One limitation of the audit design is the inability to follow individual patients longitudinally, if more than one procedure is performed. This makes assessment of the total number of cases ultimately having either primary total thyroidectomy (*single procedure*) or completion thyroidectomy impossible. *Completion thyroidectomy for cancer* remains, however, a sufficiently frequent indication for lobectomy that it is likely that the majority of cancer cases are treated in this way.

The data below, and in previous sections, cumulatively suggest that:

The low rate of primary total thyroidectomy for papillary, and even more particularly for follicular/Hürthle cell cancers, is largely due to the limitations of definitive pre-operative (FNAC) diagnosis. When FNAC is C5, then, at least for PTC, almost all undergo primary total thyroidectomy.

The higher rate of primary total thyroidectomy for medullary cancer may also be partly due to its higher definitive pre-operative FNAC diagnosis rate.

For PTC, other factors that clearly influence primary total thyroidectomy rates are:

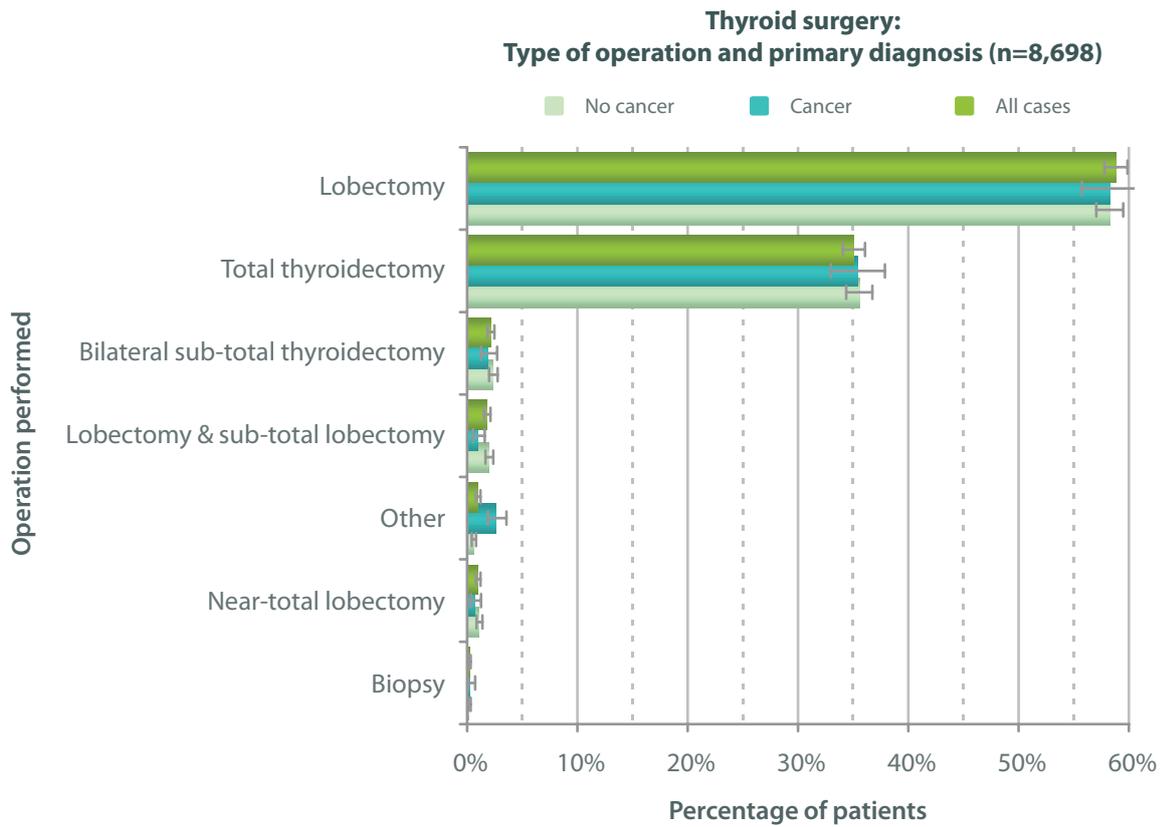
- Tumour size.
- Other known risk factors *e.g.*, age, gender.
- Pre-operative MDT discussion if FNAC is equivocal (C3-4).

Such discussion appears to more than double the likelihood of primary total thyroidectomy for PTC. This may reflect either the utility of the MDT discussion itself or that other factors not recorded in this audit (*e.g.*, imaging results) that impinge on the decision regarding extent of thyroidectomy may also increase the chance of a case being discussed at the MDT prior to surgery.

Thyroid surgery: operation performed and primary diagnosis; data accumulated after the first revision of the registry

		Primary diagnosis of cancer ¹			
		No	Yes	Unspecified	All
Operation performed	Total thyroidectomy	2,254	532	264	3,050
	Lobectomy & sub-total thyroidectomy	126	14	17	157
	Lobectomy	3,695	876	547	5,118
	Bilateral sub-total lobectomy	149	28	9	186
	Near-total lobectomy	69	10	6	85
	Biopsy	11	4	2	17
	Other	37	39	9	85
	Unspecified	764	118	644	1,526
	All	7,105	1,621	1,498	10,224

1. C-cell hyperplasia included.



Surgery for thyroid disease

At first sight, there appears little difference in the extent of surgery between benign and malignant cases. However, as discussed above, for many of the cancer cases undergoing lobectomy, this was a diagnostic procedure, and would frequently have been followed by a completion thyroidectomy.

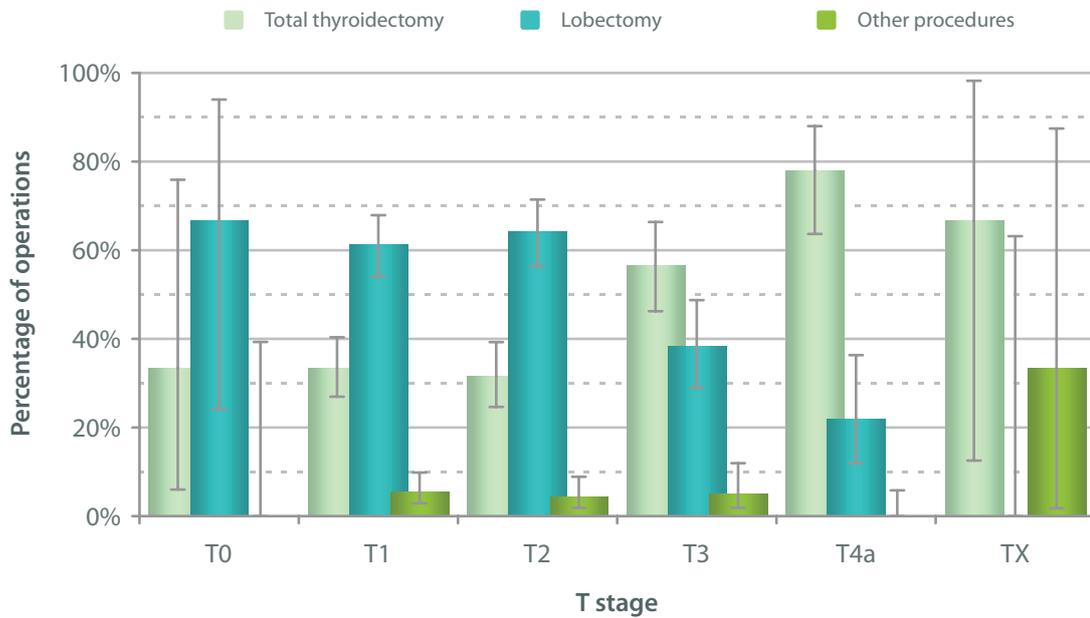


Operations for papillary thyroid cancer

For papillary thyroid cancer, the proportion of cases undergoing primary total thyroidectomy increases with T-stage. This is expected, as:

- Lobectomy may be considered adequate treatment for some small tumours.
- Tumour stage is correlated with the rate of pre-operative diagnosis (C5/Thy5) on FNAC: 23% for T1; 29% for T2; 45% for T3; 64% for T4.
- Other clinical or radiological features may increase the pre-operative suspicion of cancer with more advanced T-stage.

Thyroid surgery for papillary thyroid cancer:
Type of operation and cancer staging (n=524)







First-time surgery

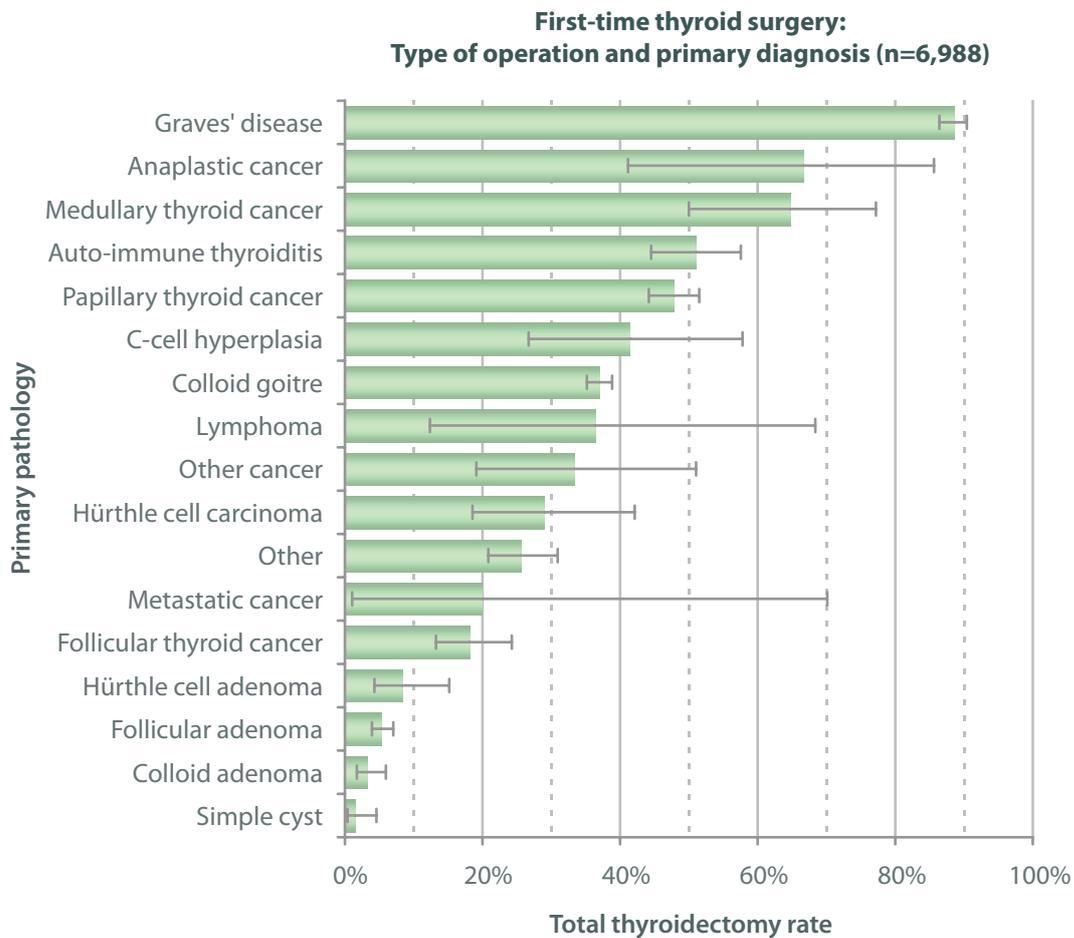
Type of operation and pathology

For first-time surgery, the rate of primary total thyroidectomy for papillary, follicular and Hürthle cell cancers is lower than that for other thyroid cancers and for some benign diseases. This is explored in more detail in the analyses on the following 3 pages.

First-time thyroid surgery: primary pathology and operation; data accumulated after the first revision of the registry

Surgery for thyroid disease

	Operation								All
	Total thyroidectomy	Lobectomy & sub-total lobectomy	Lobectomy	Bilateral sub-total lobectomy	Near-total lobectomy	Biopsy	Other	Unspecified	
Anaplastic cancer	12	1	4	0	0	1	0	3	21
Auto-immune thyroiditis	121	8	96	10	0	1	1	22	259
C-cell hyperplasia	17	0	19	4	1	0	0	4	45
Colloid adenoma	11	3	318	0	3	0	1	44	380
Colloid goitre	1,004	60	1,534	68	35	1	12	290	3,004
Follicular adenoma	46	1	802	4	14	0	5	80	952
Follicular thyroid cancer	37	1	162	1	2	0	1	12	216
Graves' disease	914	46	10	54	1	0	7	83	1,115
Hürthle cell adenoma	10	0	106	3	1	0	0	10	130
Hürthle cell carcinoma	18	3	38	1	1	0	1	2	64
Lymphoma	4	0	4	0	0	3	0	5	16
Metastatic cancer	1	0	2	0	0	0	2	0	5
Medullary thyroid cancer	33	0	16	1	0	1	0	4	55
Papillary thyroid cancer	354	7	357	17	3	1	1	44	784
Simple cyst	3	0	195	0	1	2	3	56	260
Other cancer	12	1	19	3	1	0	0	1	37
Other	78	4	208	4	4	1	6	82	387
Unspecified	221	16	411	8	4	2	4	112	778
All	2,896	151	4,301	178	71	13	44	854	8,508





This analysis examines those factors known pre-operatively that might influence the probability of a total thyroidectomy being performed at the first operation (where PTC or MTC were the primary diagnoses).

For PTC it is clear that this probability is increased by:

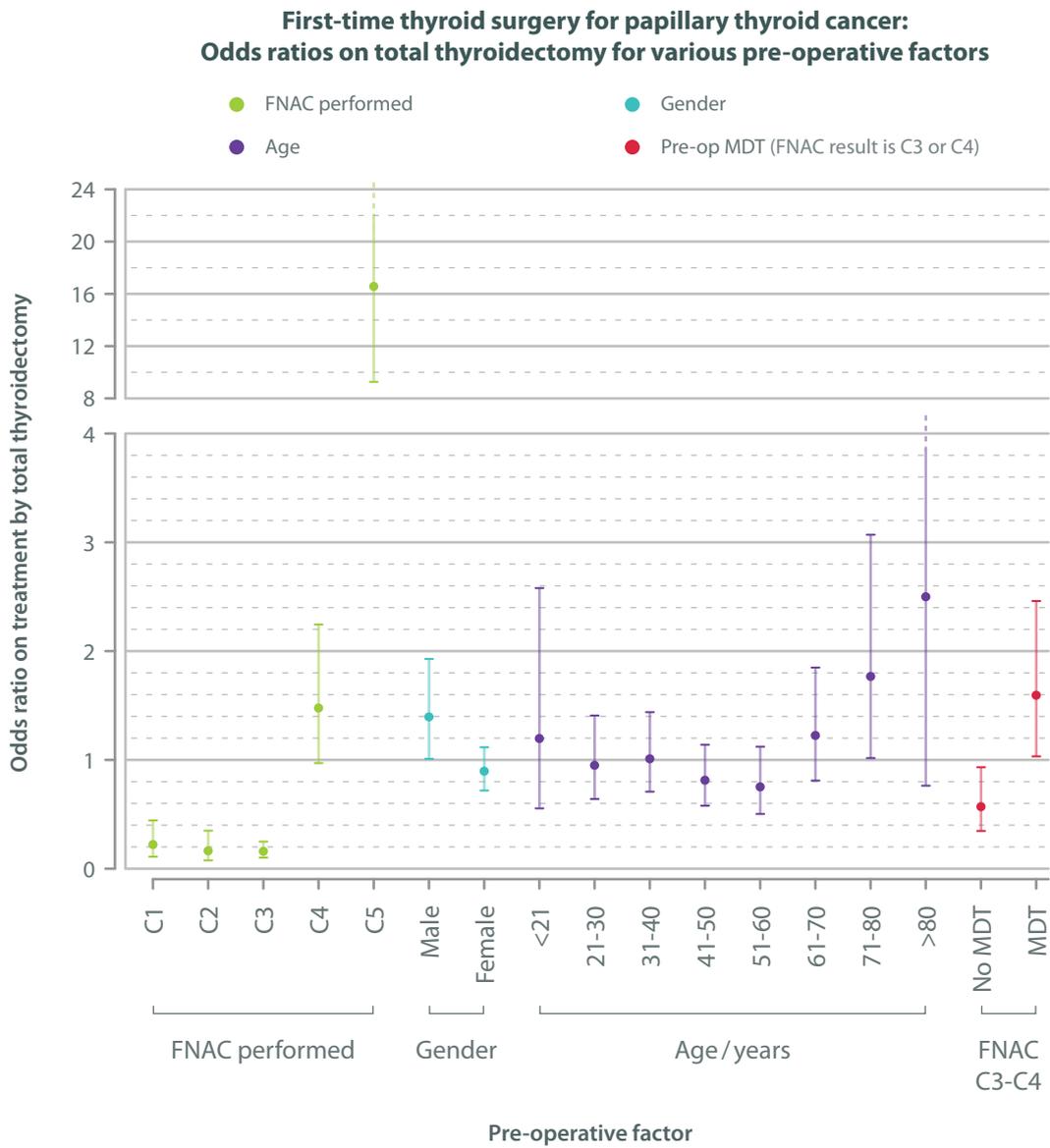
- Cytology result.
- Factors which raise the clinical index of suspicion: male gender and age <21 or >70 years.
- Pre-operative MDT discussion, where cytology is equivocal.

For MTC, case numbers are smaller, though pre-operative MDT discussion may also be relevant.

First-time thyroid surgery for papillary thyroid cancer: odds on total thyroidectomy; data accumulated after the first revision of the registry

Surgery for thyroid disease

			Total thyroidectomy			
			No	Yes	Rate	Odds ratio <i>versus</i> overall (95% CI)
Pre-operative factors	FNAC result where FNAC performed	C1	49	10	16.9%	0.22 (0.11-0.44)
		C2	53	8	13.1%	0.16 (0.08-0.35)
		C3	170	25	12.8%	0.16 (0.10-0.25)
		C4	44	60	57.7%	1.48 (0.97-2.24)
		C5	13	199	93.9%	16.57 (9.26-29.67)
		Unspecified	4	1	20.0%	0.27 (0.03-2.43)
		All	328	303		
	Gender	Male	82	103	55.7%	1.39 (1.01-1.93)
		Female	310	250	44.6%	0.90 (0.72-1.12)
		Unspecified	0	0	NA	NA
		All	392	353		
	Age at surgery / years	<21	13	14	51.9%	1.20 (0.55-2.58)
		21-30	62	53	46.1%	0.95 (0.64-1.41)
		31-40	77	70	47.6%	1.01 (0.71-1.44)
		41-50	97	71	42.3%	0.81 (0.58-1.14)
		51-60	68	46	40.4%	0.75 (0.50-1.12)
		61-70	49	54	52.4%	1.22 (0.81-1.85)
		71-80	22	35	61.4%	1.77 (1.02-3.07)
		>80	4	9	69.2%	2.50 (0.76-8.18)
		Unspecified	0	1	100.0%	NA
	All	392	353			
MDT for FNAC C3-C4	No MDT	115	26	18.4%	0.57 (0.35-0.93)	
	MDT	79	50	38.8%	1.59 (1.03-2.46)	
	Unspecified	20	9	31.0%	1.13 (0.50-2.59)	
	All	214	85			





First-time thyroid surgery for medullary thyroid cancer: odds on total thyroidectomy; data accumulated after the first revision of the registry

Surgery for thyroid disease

		Total thyroidectomy				
		No	Yes	Rate	Odds ratio <i>versus All</i> (95% CI)	
Pre-operative factors	FNAC result where FNAC performed	C1	1	0	0.0%	NA
		C2	0	1	100.0%	NA
		C3	8	0	0.0%	2.5 (0.26-24.10)
		C4	1	5	83.3%	8.0 (0.94-68.41)
		C5	1	16	94.1%	NA
		Unspecified	0	0	NA	NA
		All	11	22		
	Gender	Male	9	20	69.0	1.18 (0.44-3.11)
		Female	9	14	60.9	0.82 (0.30-2.27)
		Unspecified	0	0	NA	NA
		All	18	34		
	Age at surgery / years	<21	0	6	100.0	NA
		21-30	2	2	50.0	0.53 (0.07-4.08)
		31-40	1	6	85.7	3.18 (0.35-28.46)
		41-50	4	6	60.0	0.79 (0.20-3.18)
		51-60	3	8	72.7	1.41 (0.33-5.99)
		61-70	6	1	14.3	0.09 (0.01-0.79)
		71-80	0	5	100.0	NA
		>80	2	0	0.0	NA
Unspecified		0	0	NA	NA	
All	18	34				
MDT for FNAC C3-C4	No MDT	5	0	0.0	NA	
	MDT	3	4	57.1	2.40 (0.38-15.32)	
	Unspecified	1	1	50.0	1.80 (0.09-35.43)	
	All	9	5			



Lymph node dissection for cancer

Again, the difficulty of following patients longitudinally across more than one procedure makes it impossible to determine the proportion of cancer cases overall who receive lymph node surgery, as this may be performed at the first or any number of subsequent procedures.

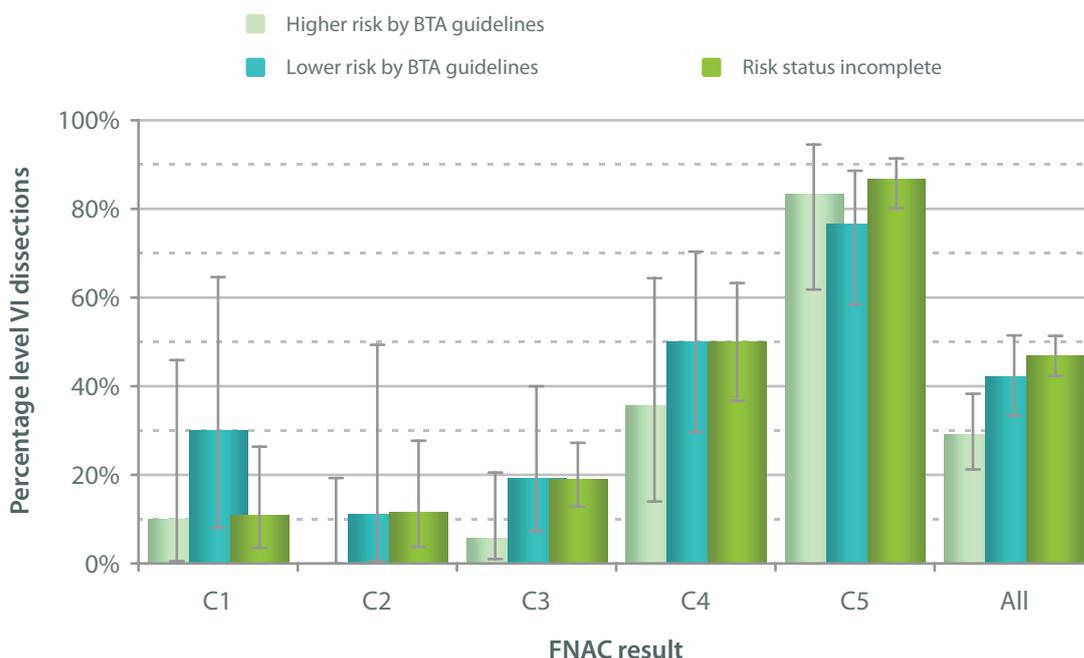
The following data however show that, for first-time operations for PTC:

The rate of primary level VI node dissection is largely determined by the confidence of pre-operative (FNAC) diagnosis: where FNA is C5, the vast majority undergo Level VI dissection, of which a substantial proportion are *prophylactic* in intent (judged from the overall >40% rate of N0 nodal stage).

Opinion varies on the need for (prophylactic) level VI dissection for PTC, with a selective approach clearly being favoured in many centres. There remains however a very large variation in the rate of such dissection, unlikely to be due solely to variation in known risk factors for nodal disease. The BTA guidelines suggest that even for clinically uninvolved nodes, level VI dissection should be performed if the patient is higher risk due to male gender, age >45 years or T3/4 tumours. Not all such patients undergo this dissection, even with C5 diagnosis pre-op. Also, the proportion undergoing Level VI dissection is little different overall between those cases meeting and those not meeting these criteria. This may imply that members do not believe in the guidance, or it may be that there is considerable variation between members in the proportion of cases having clinically involved nodes.

A significant number of members perform level VI dissections relatively infrequently: this might argue in favour of greater centralisation of this type of surgery.

**First-time thyroid surgery for papillary thyroid cancer:
Level VI node dissection rates by FNAC result**



Data for first-time surgery for MTC are as follows:

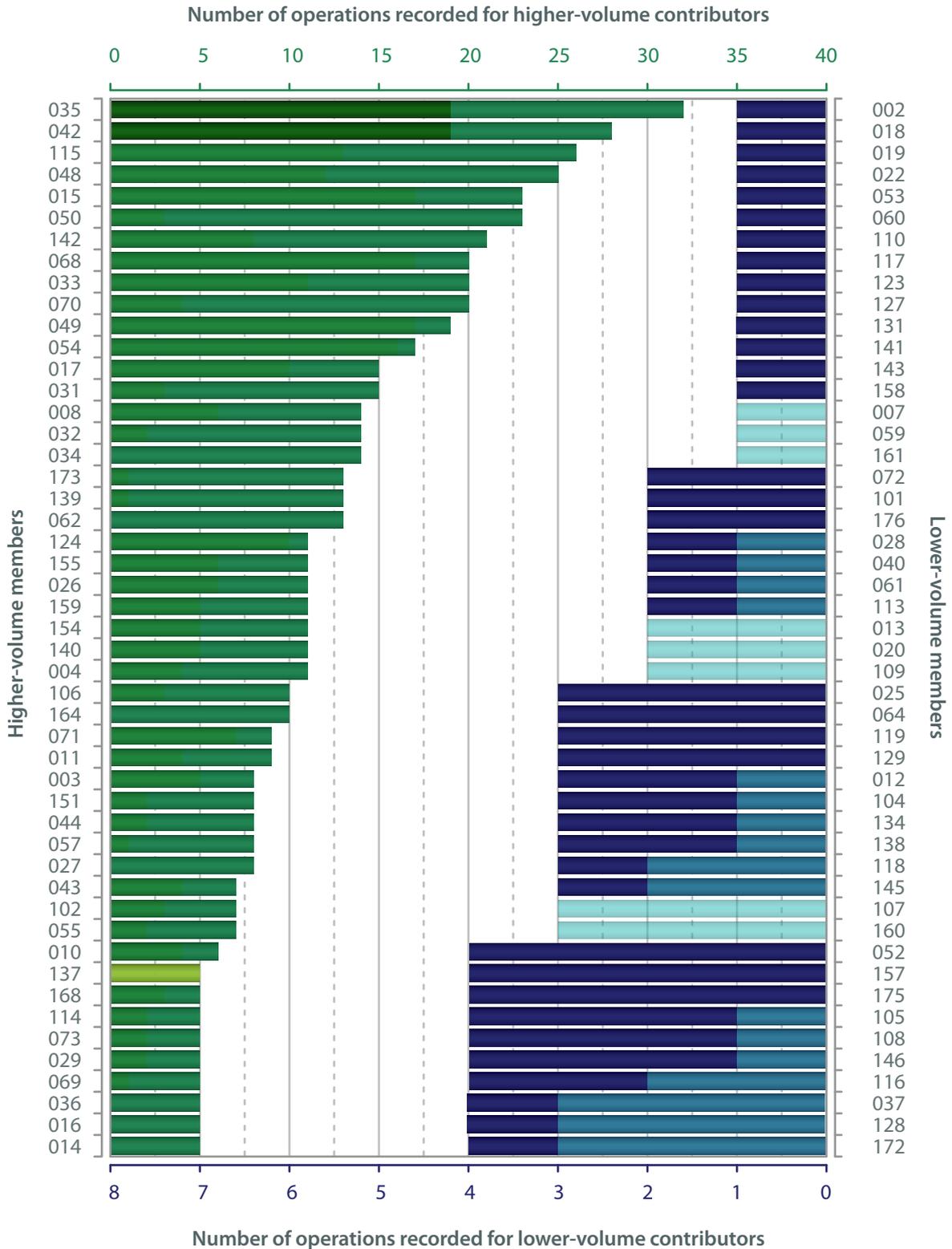
- C1 0.0% (0 / 1)
- C2 NA (0)
- C3 0.0% (0 / 7)
- C4 83.3% (5 / 6)
- C5 100.0% (16 / 16)



First-time thyroid surgery for papillary thyroid cancer: reported level VI dissection rates by each member

With level VI dissection Total procedure count
 Higher-volume contributors (n=272) (n=612)
 Lower-volume contributors (n=41) (n=113)

Surgery for thyroid disease

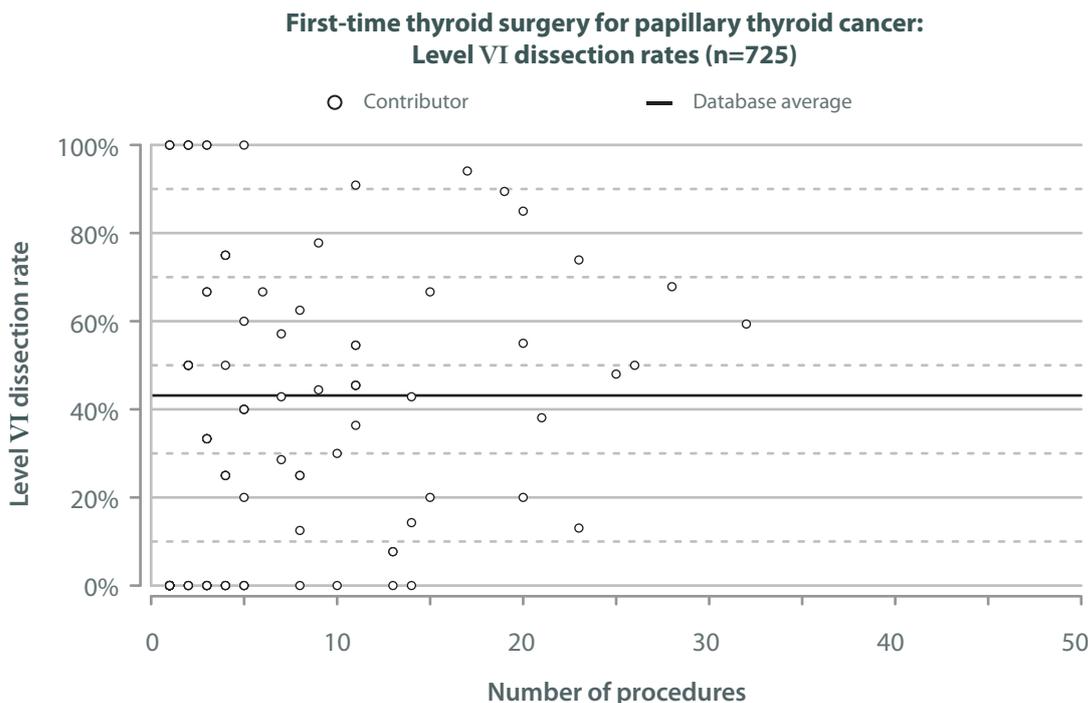




There appears to be considerable variation between members with respect to rates of level VI dissection at first surgery for PTC.

This may be due to:

- Differences in rates of pre-operative cancer (C5/Thy5) diagnoses on FNAC.
- Differences in case-mix between surgeons.
- Variation in thresholds for lymphadenectomy between units/surgeons.



First-time thyroid surgery for papillary thyroid cancer: lateral and central neck dissections alone or in combination

		Data	
		Count	Proportion
Nodes dissected	None	423	55.8%
	2-4 ± 6	17	2.2%
	2-5 ± 6	70	9.2%
	6 ± 7	191	25.2%
	Others	57	7.5%
	Unspecified	26	
	All	784	

Where (first-time) neck dissection was performed for papillary thyroid cancer, in just over half of cases this involved central lymphadenectomy alone.

Of the remainder, most had formal dissection of levels II-V in addition to central neck dissection. Presumably, these were cases presenting with abnormal lateral neck nodes.



Re-operative surgery

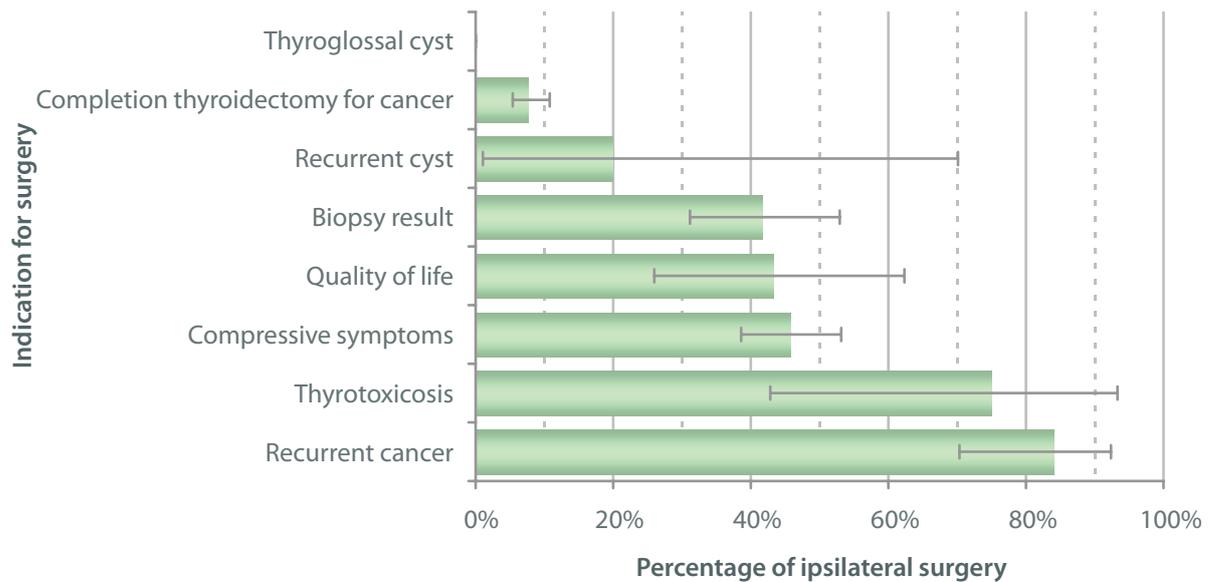
The commonest indication for re-operative surgery is *completion thyroidectomy for cancer*, representing 53% of cases where indication is recorded. As expected, most of these are contralateral lobectomies alone.

Indeed, the large majority of all re-operative cases are unilateral lobectomies. Bilateral resections account for only around 15% of all re-do cases within the whole database.

Redo thyroid surgery: indication for surgery and side of previous surgery; data accumulated after the first revision of the registry

		Same side as previous surgery			
		No	Yes	Unspecified	Ipsilateral rate
Indication for surgery	Thyrotoxicosis	3	9	0	75.0%
	Compressive symptoms	103	87	22	45.8%
	Quality of life	17	13	4	43.3%
	Recurrent cyst	4	1	0	20.0%
	Biopsy result	49	35	18	41.7%
	Completion thyroidectomy for cancer	385	32	58	7.7%
	Recurrent cancer	8	42	12	84.0%
	Thyroglossal cyst	0	0	0	NA
	Unspecified	17	14	22	45.2%
	All	586	233	136	28.4%

Redo thyroid surgery: Indication for surgery and side of previous surgery (n=788)





Grade of surgeon

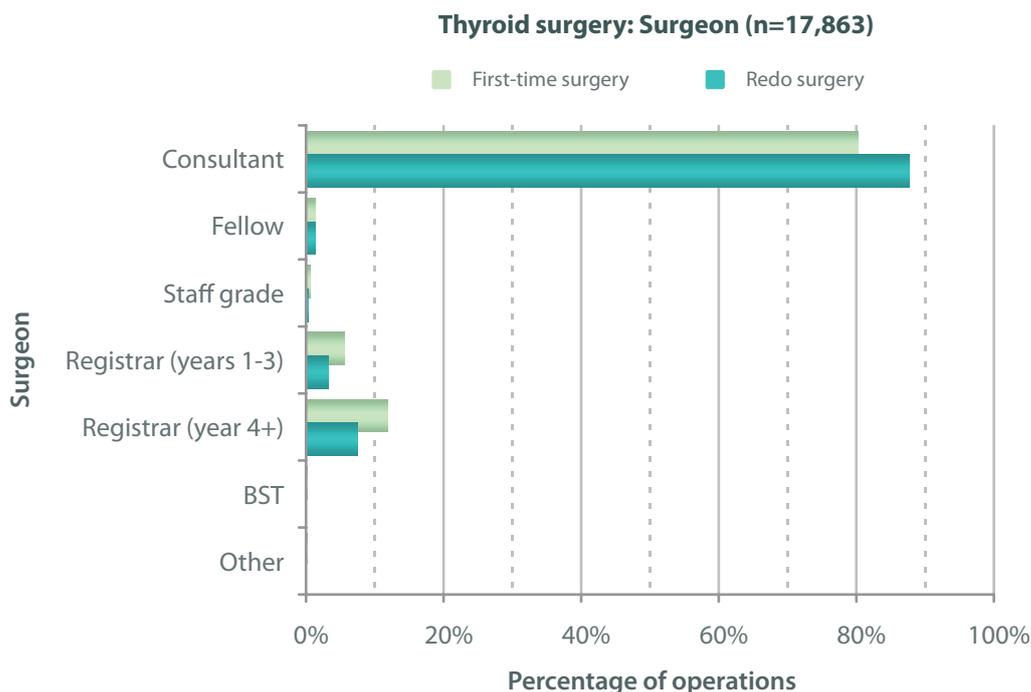
As detailed in the 2009 report, the collection of data on grade of primary and assistant surgeons does not allow recognition that a part of the operation may have been undertaken by a trainee. This may lead to under-estimation of the extent of trainees' involvement as primary surgeon.

Nonetheless, a middle-grade surgeon was recorded as primary surgeon in only 3,369 cases over the whole life-time of the database, less than 500 cases *per year* since introduction of the electronic database. Over time, if anything, there has been a slight downward trend in the proportion of cases performed by trainees as primary surgeon. Spread across the breadth of all surgical trainees in the United Kingdom, this might imply a limited exposure to thyroid surgery, although it is likely that this exposure will actually be concentrated in the hands of a small cohort of sub-speciality trainees.

Reassuringly for training, where a trainee is primary surgeon, a consultant is the assistant in the great majority of cases.

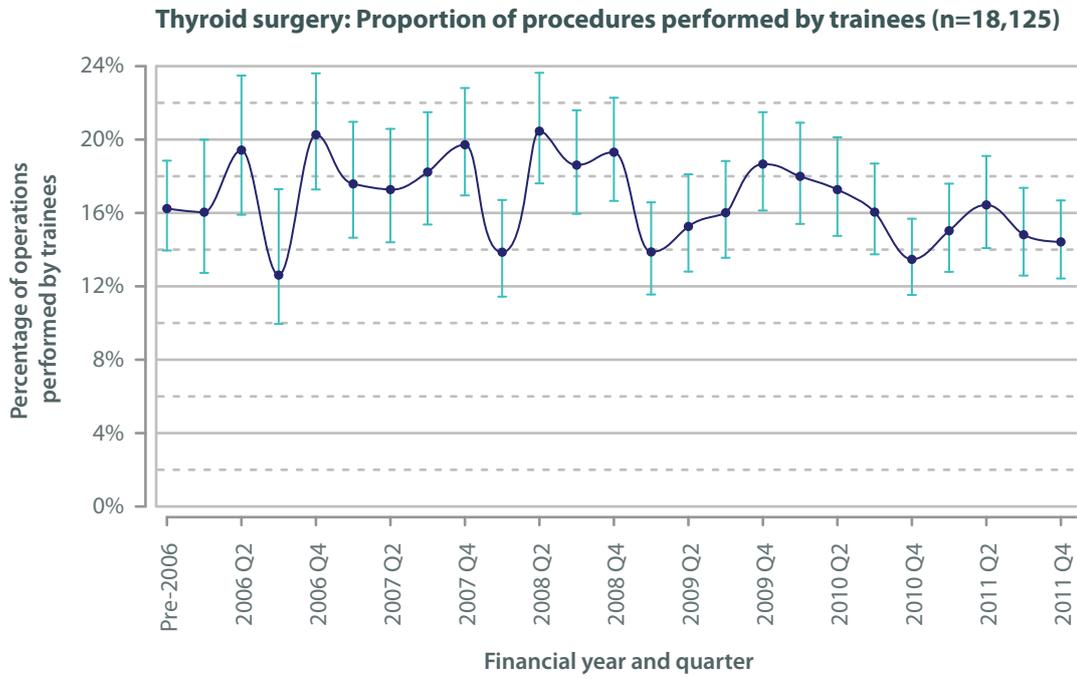
Thyroid surgery: surgeon and operation sequence; data taken over the life of the database

		Operation sequence			
		First-time	Redo	Unspecified	All
Surgeon	Consultant	12,820	1,646	234	14,700
	Fellow	221	25	2	248
	Staff grade	92	6	1	99
	Registrar (years 1-3)	898	60	10	968
	Registrar (years 4+)	1,899	140	15	2,054
	BST	38	1	0	39
	Other	17	0	0	17
	Unspecified	134	21	624	779
	All	16,119	1,899	886	18,904





Surgery for thyroid disease



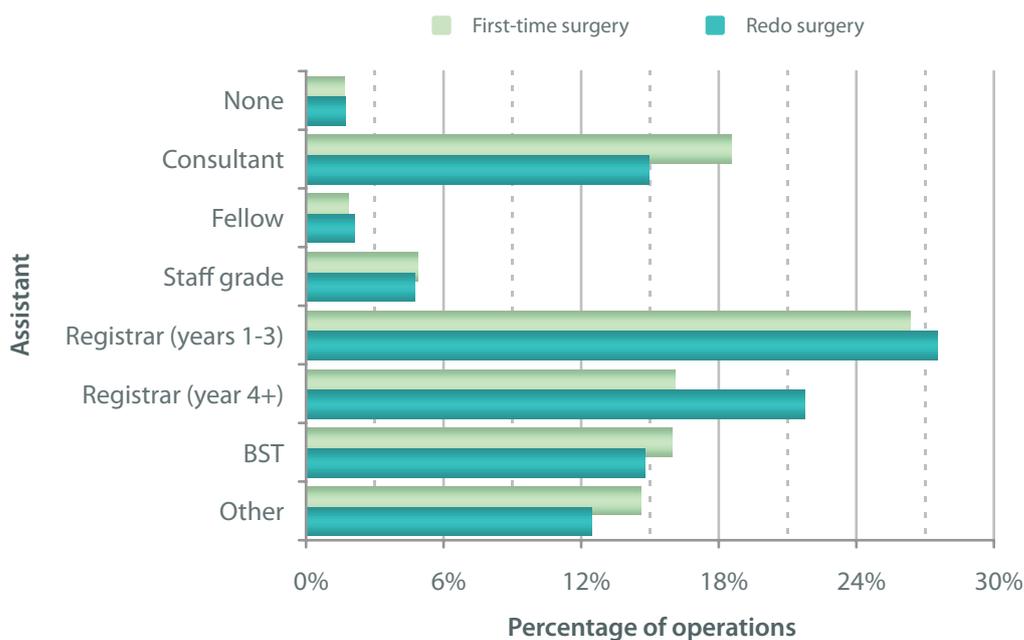


Grade of assistant

Thyroid surgery: assistant and operation sequence; data taken over the life of the database

		Operation sequence			
		First-time	Redo	Unspecified	All
Assistant	None	258	31	1	290
	Consultant	2,865	270	31	3,166
	Fellow	287	38	3	328
	Staff grade	755	86	8	849
	Registrar (years 1-3)	4,067	498	42	4,607
	Registrar (years 4+)	2,487	393	23	2,903
	BST	2,462	267	26	2,755
	Other	2,255	225	33	2,513
	Unspecified	683	91	719	1,493
	All	16,119	1,899	886	18,904

Thyroid surgery: Assistant (n=14,764)





Consultant involvement

Thyroid surgery is clearly consultant-led, with the vast majority of cases involving a consultant as either primary surgeon or assistant. This has remained a consistent feature over time, as noted in previous reports.

Consultant involvement rates are as follows:

- All surgery 95.9% (18,110; 95.6-96.2%).
- First-time operations 95.7% (15,972; 95.4-96.0%).
- Redo surgery 96.7% (1,876; 95.8-97.5%).



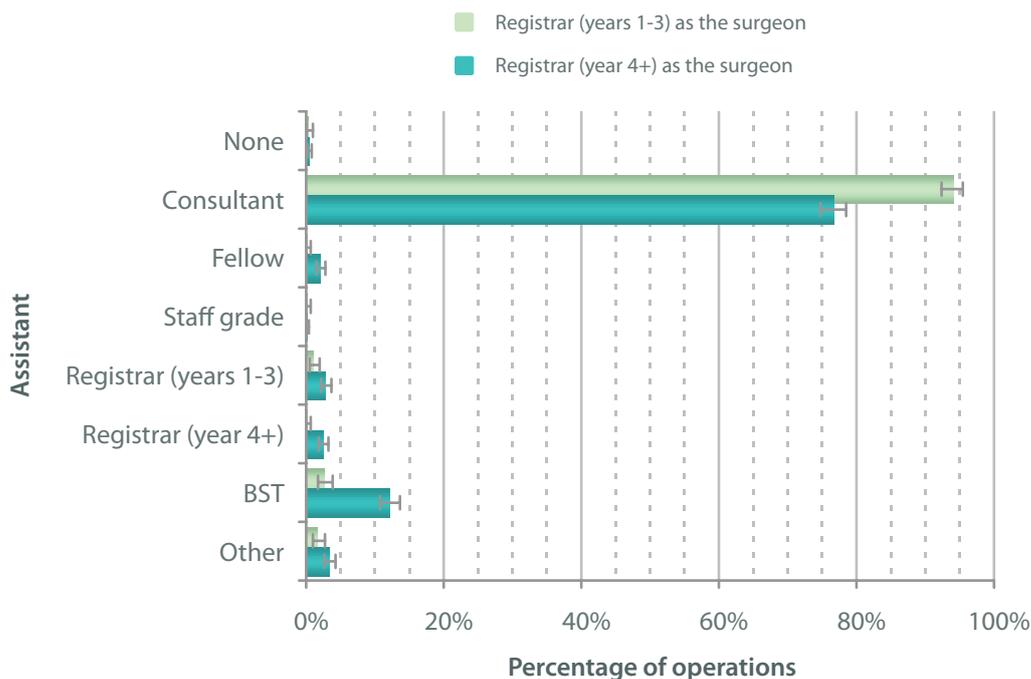
Surgeon & assistant

Dual operating by two consultants occurred in 2.9% of cases where the surgeon and assistant were both recorded. This raises the issue of joint operating and how outcomes for each consultant member should be entered in these circumstances, as this has sometimes led to duplicate entries being made. The structure of the database ought to be changed to allow members to register their involvement, but to ensure that outcome of an individual operation is only entered once.

Thyroid surgery: surgeon and assistant combinations; data taken over the life of the database

		Assistant								
		None	Consultant	Fellow	Staff grade	Registrar (years 1-3)	Registrar (years 4+)	BST	Other	Unspecified
Surgeon	Consultant	279	504	284	845	4,491	2,774	2,456	2,360	707
	Fellow	0	58	0	0	34	75	13	64	4
	Staff grade	0	82	0	1	6	0	6	4	0
	Registrar (years 1-3)	3	909	1	1	10	1	25	16	2
	Registrar (years 4+)	8	1,569	42	2	58	50	248	69	8
	BST	0	36	1	0	0	2	0	0	0
	Other	0	8	0	0	5	0	3	0	1
	Unspecified	0	0	0	0	3	1	4	0	771
	All	290	3,166	328	849	4,607	2,903	2,755	2,513	1,493

**Thyroid surgery performed by a trainee:
Assistant (n=3,012)**





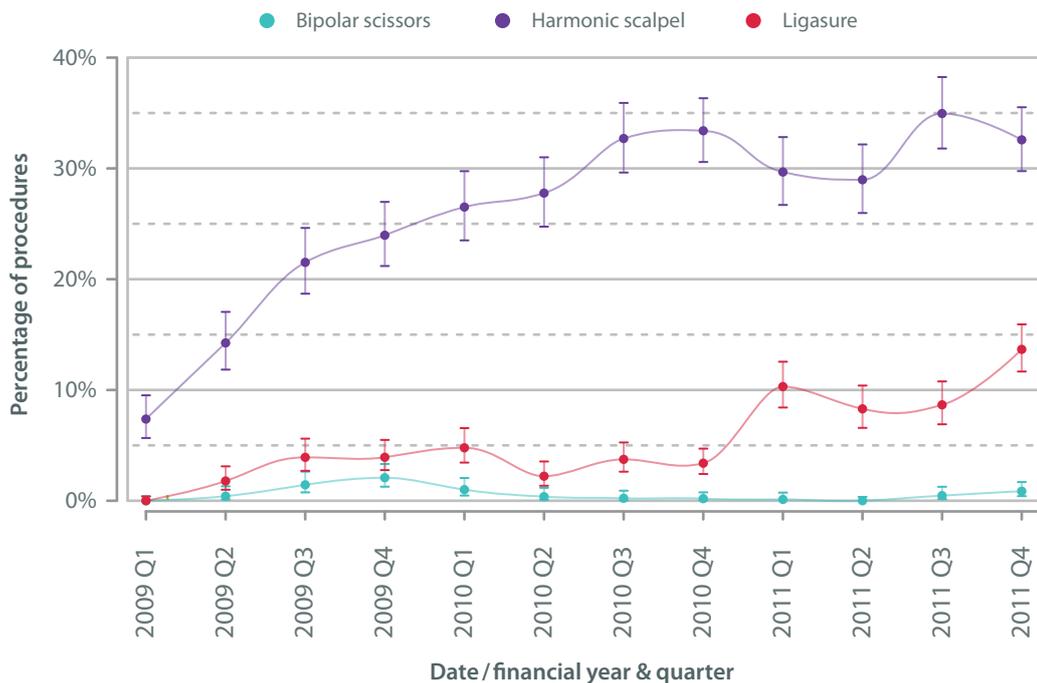
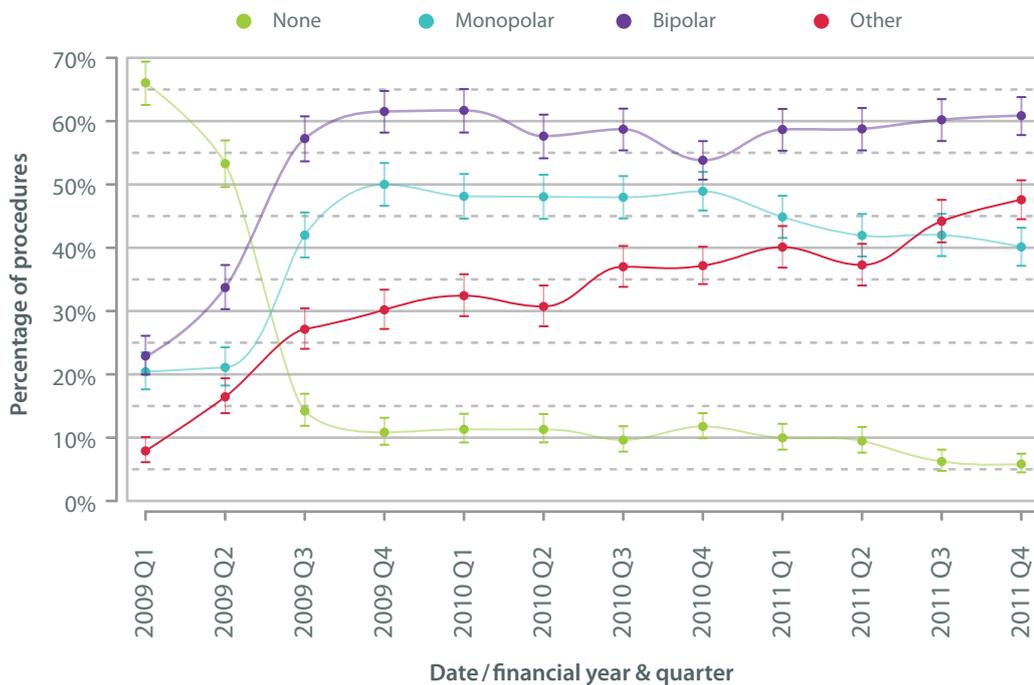
Energy source

There has been an apparent large expansion in the use of newer technologies for tissue cutting / vessel sealing, in particular, the use of the Harmonic scalpel and, more recently, Ligasure devices.

For Ligasure, 22 members report usage in at least one case, whilst for Harmonic scalpel 60 members do so. There is some evidence that use of these technologies is more favoured for bilateral than unilateral resections: Ligasure 49% bilateral; Harmonic scalpel 46% bilateral; compared to a 35% bilateral rate across the database as a whole. This may be due to economic considerations.

There is no evidence to suggest greater use of alternative technologies in cancer cases, compared to benign disease (technologies used in 17% of cases with a cancer diagnosis *versus* 15% overall).

Thyroid surgery: Energy source (n=10,335)





Nerve monitoring

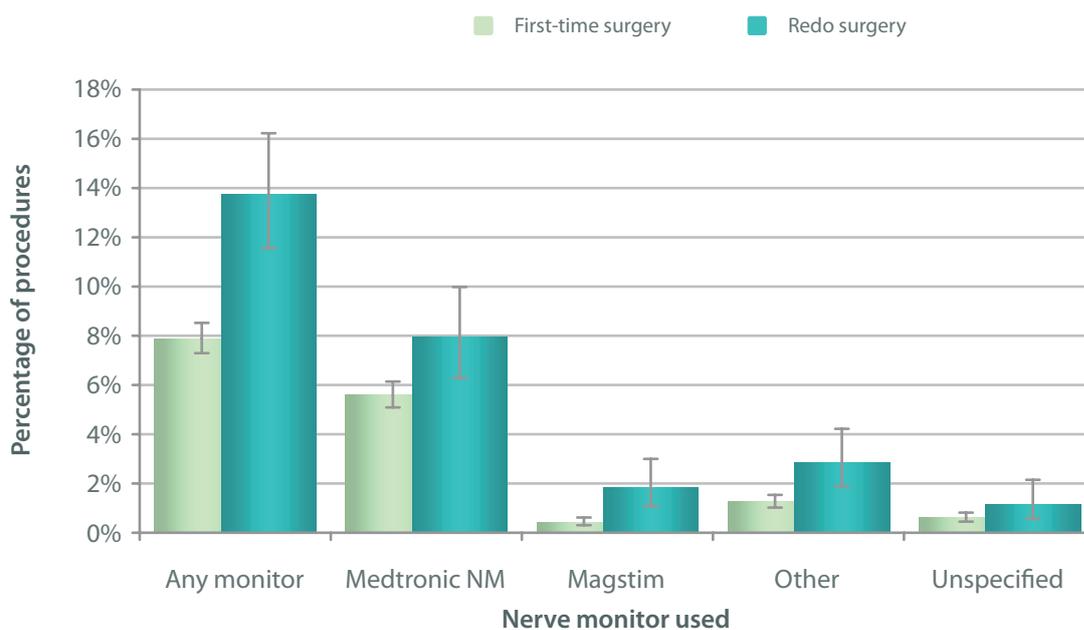
Nerve monitoring refers to a variety of devices used to confirm the identification and preservation of the recurrent laryngeal nerve during thyroid surgery. Although the purpose of this process is to help avoid injury to the nerve, there is debate as to its efficacy, and it is interesting therefore to note that in the United Kingdom use of any nerve monitor remains relatively infrequent. There is evidence of selective usage, particularly for re-operative surgery. For cases where information on use of nerve monitoring is present, the membership appears to be split into 3 groups:

- Never users, 63%.
- Selective users, 29% (reporting usage between 0.6-84.0% of their own cases).
- Routine users, 8% (usage in $\geq 90.0\%$ of their own cases).

Thyroid surgery: nerve monitoring and operation sequence; data accumulated after the first revision of the registry

		Operation sequence				
		Counts			Percentage	
		First-time	Redo	Unspecified	First-time	Redo
Nerve monitor	None	6,984	760	62	92.1%	86.3%
	Medtronic NM	424	70	5	5.6%	7.9%
	Magstim	33	16	1	0.4%	1.8%
	Other	95	25	1	1.3%	2.8%
	Unspecified monitor	46	10	0	0.6%	1.1%
	Unspecified	926	74	692		
	All	8,508	955	761		

Thyroid surgery: Nerve monitoring (n=8,463)





General outcomes

Hypocalcaemia

This refers to the incidence of low serum calcium levels in the immediate post-operative period. This is an important outcome, as it can result in troublesome symptoms, and has the potential for life-threatening complications if untreated. Since the last revision of the database, the definition of hypocalcaemia has been more rigid (*First day corrected calcium <2.10 mmol l⁻¹ or <1.2 mmol l⁻¹ ionised*), and appears as a pop-up dialogue box within the relevant data entry field, to aid members' interpretation.

Hypocalcaemia after total thyroidectomy

The more rigid application of this definition may partly explain the apparent small reduction in the hypocalcaemia rate since the last report: 27.4% (95% CI: 26.2-28.6%) for first-time total thyroidectomy *versus* 29.6% (95% CI: 28.0-31.3%) in 2009.

Total thyroidectomy: post operative hypocalcaemia; data taken over the life of the database

		Post-operative hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Sequence	First-time	3,788	1,427	370	27.4% (26.2-28.6%)
	Redo	110	45	23	29.0% (22.2-37.0%)
	Unspecified	50	13	27	20.6% (11.9-33.0%)
	All	3,948	1,485	420	27.3% (26.2-28.5%)

Hypocalcaemia after surgery for papillary thyroid cancer

Not surprisingly, hypocalcaemia is commoner with more extensive dissection in the central compartment of the neck, due to the greater potential for damage / devascularisation of parathyroid glands.

Thyroid surgery for papillary thyroid cancer: post operative hypocalcaemia; data accumulated after the first revision of the registry

		Post-operative hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Level VI dissection	None	481	45	8	8.6% (6.4-11.4%)
	Unilateral	133	29	7	17.9% (12.5-24.9%)
	Bilateral	152	89	12	36.9% (30.9-43.4%)
	Unspecified	38	2	3	5.0% (0.9-18.2%)
	All	804	165	30	17.0% (14.7-19.6%)



Hypocalcaemia after total thyroidectomy for multi-nodular goitre

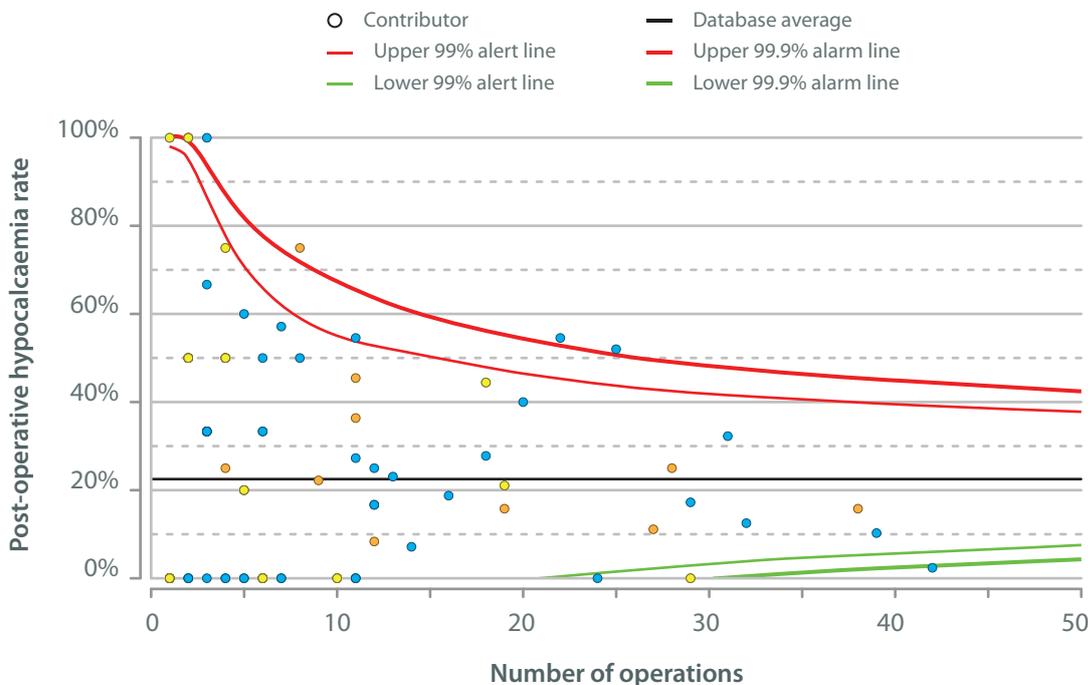
Total thyroidectomy for multi-nodular goitre: post operative hypocalcaemia; data taken over the life of the database

		Post-operative hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Sequence	First-time	779	215	24	21.6% (19.1-24.3%)
	Redo	28	10	0	26.3% (14.0-43.4%)
	Unspecified	8	0	0	0.0% (0.0-31.2%)
	All	815	225	24	21.6% (19.2-24.3%)

There are sufficient data points for this outcome measure to subdivide members' outcomes by their individual rates of missing data for hypocalcaemia.

There does not appear to be any systematic effect of this subdivision on reported hypocalcaemia rates. However, there must remain some doubt as to the accuracy of individual estimates when a substantial proportion of the data are missing. This is particularly relevant for members reporting complication rates at / outside the alert lines or rates of zero %.

**First-time total thyroidectomy for multi-nodular goitre:
Post-operative hypocalcaemia rates; financial years 2009-2011 (n=864)**



1. Orange <5% missing
2. Blue 5-20% missing
3. Yellow >20% missing



Hypocalcaemia after surgery for Graves' disease

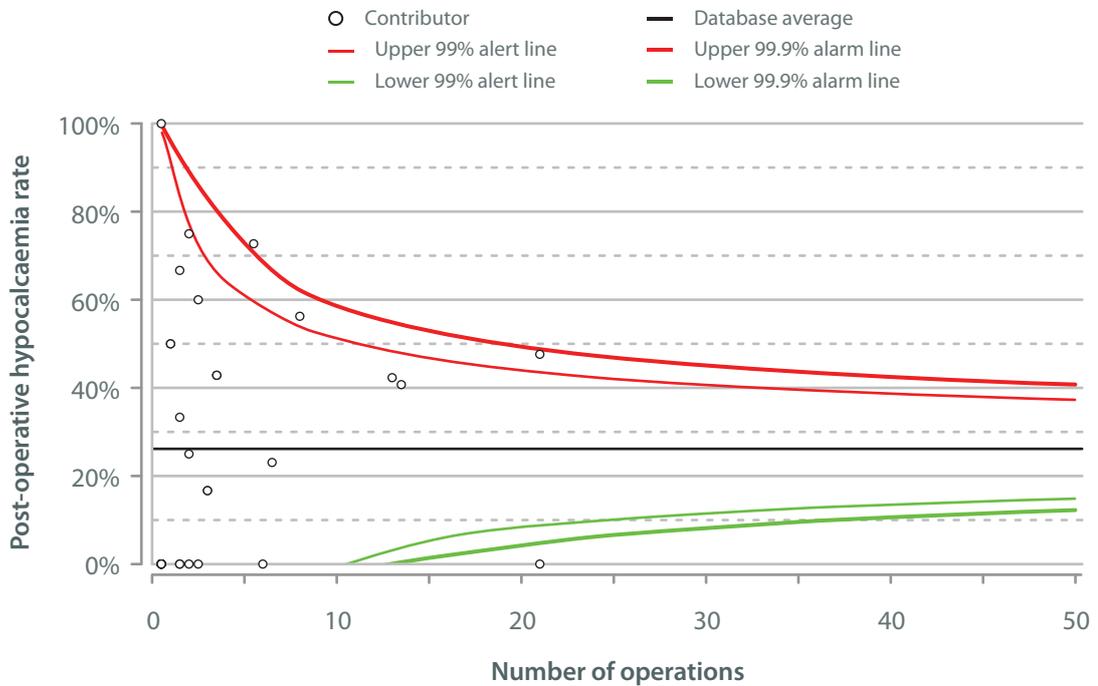
Initial hypocalcaemia is commoner after surgery for Graves' disease than for multi-nodular goitre. This is explored in more detail in multi-variate analysis later in this report. This may be a reflection of the metabolic effects of thyrotoxicosis on bone turnover (*hungry bone syndrome*).

Surgery for thyroid disease

Thyroid surgery for Graves' disease: post operative hypocalcaemia; data accumulated after the first revision of the registry

		Post-operative hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Sequence	First-time	791	281	43	26.2% (23.6-29.0%)
	Redo	5	2	0	28.6% (5.1-69.7%)
	Unspecified	4	2	37	33.3% (6.0-75.9%)
	All	800	285	80	26.3% (23.7-29.0%)

**Thyroid surgery for Graves' disease:
Post-operative hypocalcaemia rates; financial years 2009-2011 (n=1,040)**





Hypocalcaemia treatment after thyroid surgery

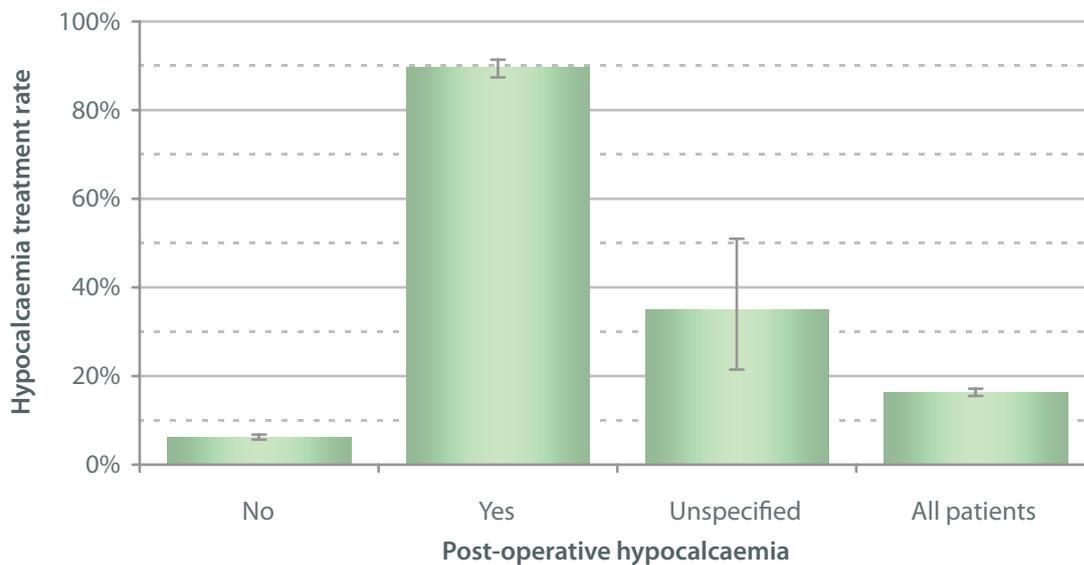
Mild hypocalcaemia may not require treatment, although it is interesting to note that of patients developing hypocalcaemia around 90% do receive such therapy. However, around 6% of non-hypocalcaemic patients also receive this treatment, suggesting that they were treated *prophylactically*, perhaps to facilitate earlier discharge home.

Also, note the relatively high rate of missing data for this end-point.

Thyroid surgery: treatment for hypocalcaemia and the occurrence of post operative hypocalcaemia; data accumulated after the first revision of the registry

		Treatment for hypocalcaemia post-operatively			
		No	Yes	Unspecified	Rate (95% CI)
Post-operative hypocalcaemia	No	6,521	431	965	6.2% (5.6-6.8%)
	Yes	99	849	16	89.6% (87.4-91.4%)
	Unspecified	28	15	1,300	34.9% (21.5-51.0%)
	All	6,648	1,295	2,281	16.3% (15.5-17.1%)

Thyroid surgery:
Rates of treatment for hypocalcaemia post-operatively (n=7,943)





Post-operative stay

In common with many other surgical procedures, the length of inpatient stay after thyroidectomy has reduced over the last few years. The data show that:

- Much of the reduction in length-of-stay has occurred due to a shift from 2-day stay to 1-day stay, with the proportions of longer durations of stay remaining relatively stable over time, and only a modest increase in true day cases (0 days).
- True day cases now account for around 6% of cases overall; 8% of lobectomies/isthmusectomies; and 1.2% of total thyroidectomies.
- Prolonged hospital stay beyond 4 days is likely to be due in most cases to co-existing morbidities and social factors. It is therefore interesting that such durations of stay are more common after total thyroidectomy than lobectomy.

One potential reason to delay discharge is monitoring/treatment of hypocalcaemia, and the data do suggest that this is a common cause of longer inpatient stay:

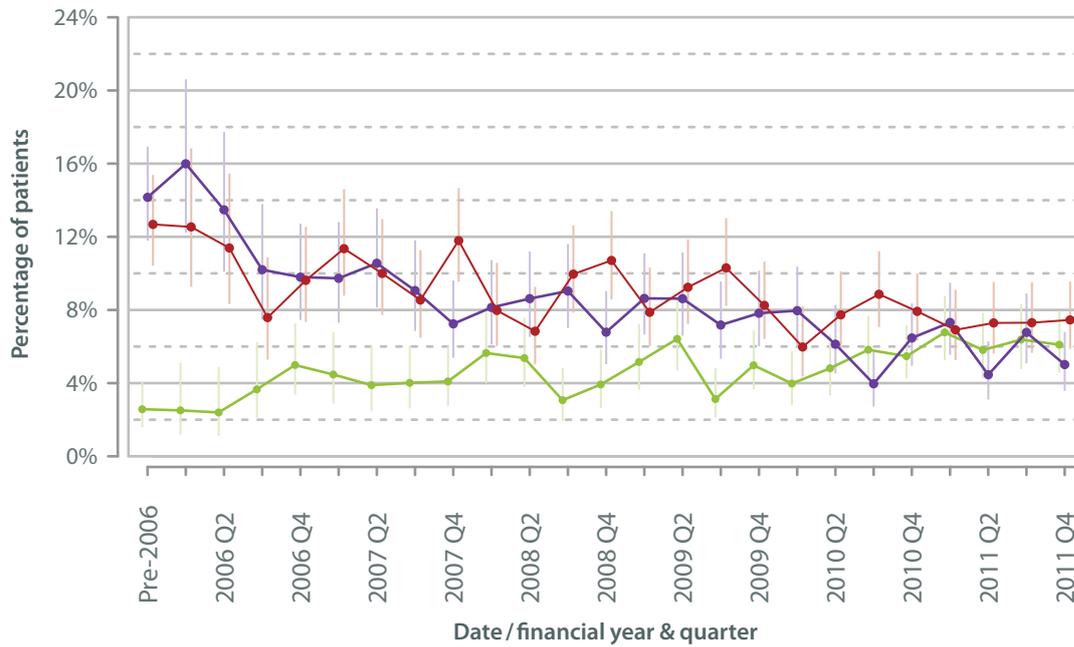
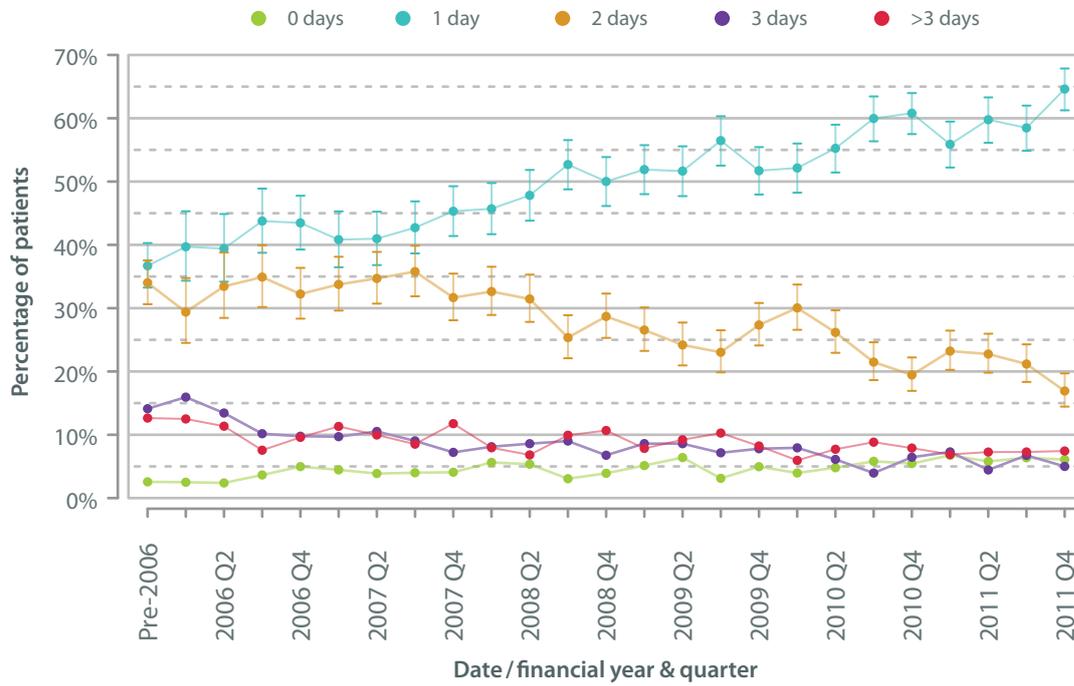
Median stay after total thyroidectomy (as determined from whole database to April 2011) was 2 days. There was, however, a significantly higher rate of hypocalcaemia in those staying >2 days compared to those staying ≤2 days (572/1,189 = 48.1%, compared to 753/3,700 = 20.4%, $\chi^2 = 349.5$, $p < 0.001$).

These findings are consistent with the generally shorter lengths-of-stay seen across many surgical specialties. Thyroid surgery may be particularly suited to such short hospital episodes, due to the less invasive nature of this surgery and relatively low levels of post-operative pain.

True daycase thyroidectomy, however, seems not to have been embraced by the membership. This may be due to the potential for life-threatening airway compromise to develop rapidly, if bleeding occurs. The risk of this complication is known to exist for up to 24 hours post-operatively, and this is likely to be deterring members from offering day case surgery in the majority of cases.



Thyroid surgery: Post-operative stay (n=15,837)





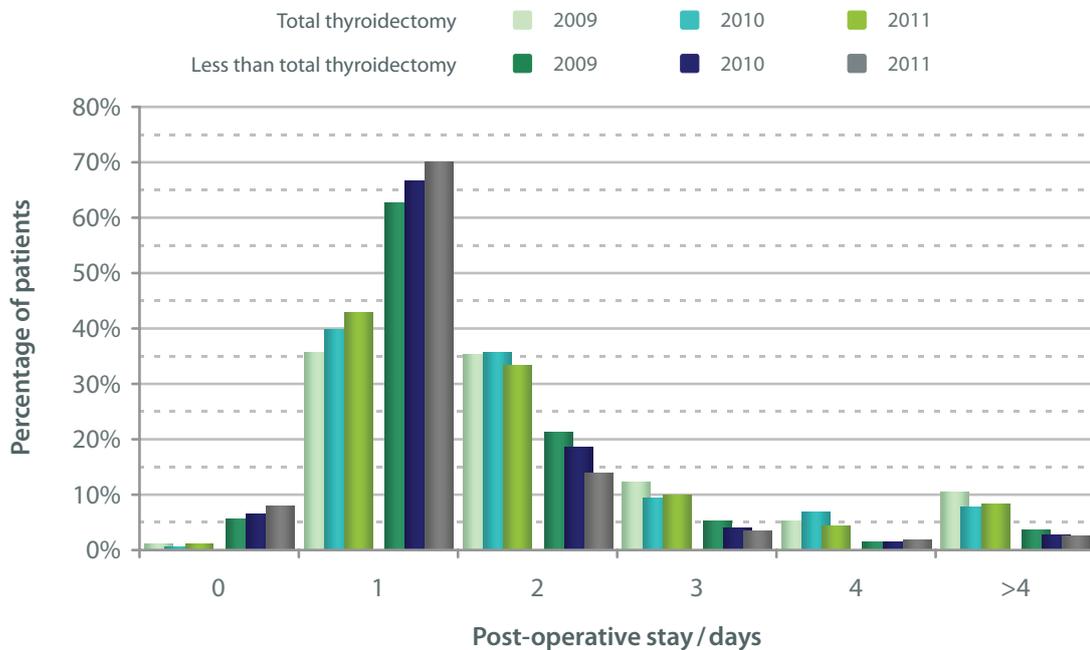
Length-of-stay is clearly related to the extent of surgery. Very few patients undergo total thyroidectomy on a daycase basis, probably due to the potential increased risks of haemorrhage compared to unilateral lobectomy, plus the need to monitor calcium levels in the first 24 hours. In-hospital stays of 4 or more days are commoner with total thyroidectomy than lesser resections, however, probably due to the need for more prolonged monitoring of calcium levels and/or treatment of hypocalcaemia in a proportion of these cases.

Thyroid surgery: post-operative stay and procedure over the financial years 2009-2011

Surgery for thyroid disease

		Procedure and financial year ending							
		Total thyroidectomy				Less than total thyroidectomy			
		2009	2010	2011	All	2009	2010	2011	All
Post-operative stay	0 days	9	5	12	26	91	115	139	345
	1 day	291	379	440	1,110	1,004	1,189	1,213	3,406
	2 days	288	339	341	968	342	331	241	914
	3 days	100	89	101	290	83	71	60	214
	4 days	43	65	45	153	23	27	31	81
	>4 days	86	74	86	246	58	49	45	152
	Unspecified	114	123	180	417	237	234	303	774
	All	931	1,074	1,205	3,210	1,838	2,016	2,032	5,886

Thyroid surgery: Post-operative stay and procedure; financial years 2009-2011 (n=7,905)

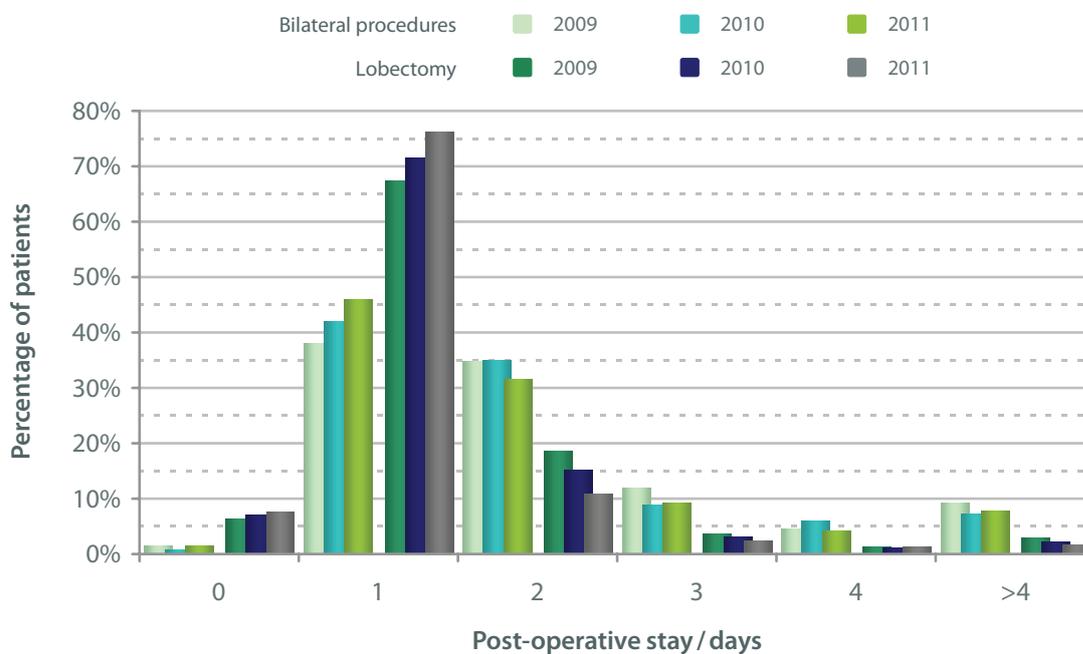




Thyroid surgery: post-operative stay and procedure over the financial years 2009-2011

		Procedure and financial year ending							
		Bilateral procedures				Lobectomy			
		2009	2010	2011	All	2009	2010	2011	All
Post-operative stay	0 days	17	10	19	46	78	97	98	273
	1 day	420	519	602	1,541	832	984	975	2,791
	2 days	385	432	413	1,230	229	209	139	577
	3 days	132	110	120	362	44	42	31	117
	4 days	50	74	56	180	15	15	16	46
	>4 days	102	89	101	292	37	30	22	89
	Unspecified	150	161	222	533	171	175	196	542
	All	1,256	1,395	1,533	4,184	1,406	1,552	1,477	4,435

Thyroid surgery: Post-operative stay and procedure; financial years 2009-2011 (n=7,544)





Post-operative laryngoscopy / voice check

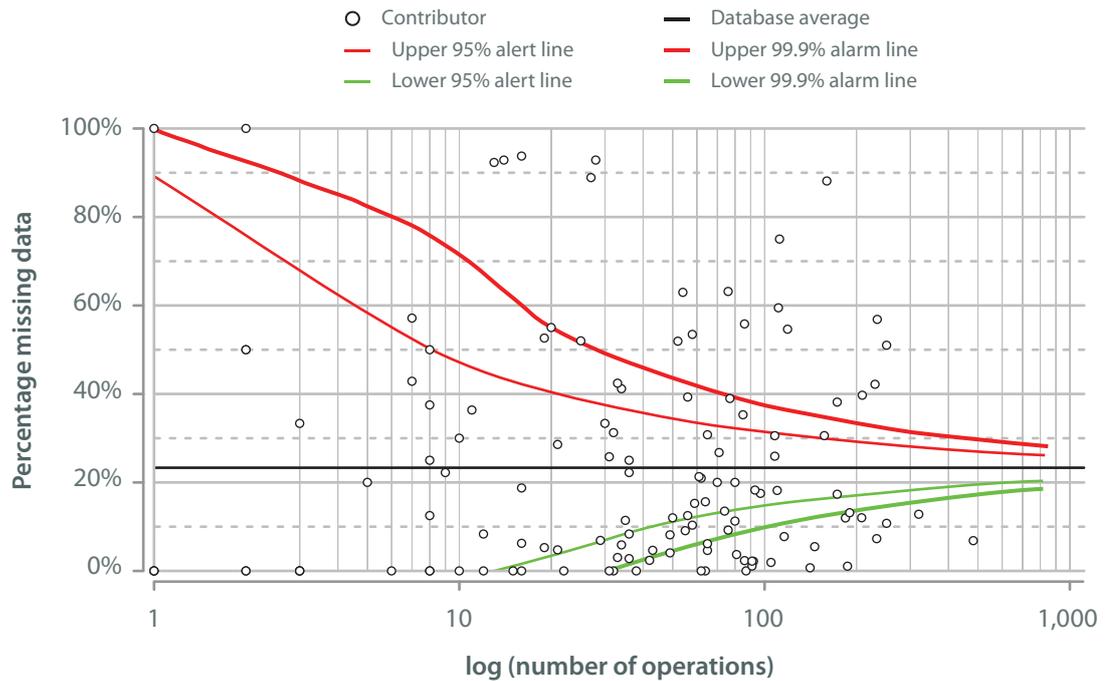
Data on the use of post-operative laryngoscopy raise several concerns:

The rate of missing data is particularly high for this field, remaining unrecorded in >20% of entries, with large variation between members with respect to data completeness.

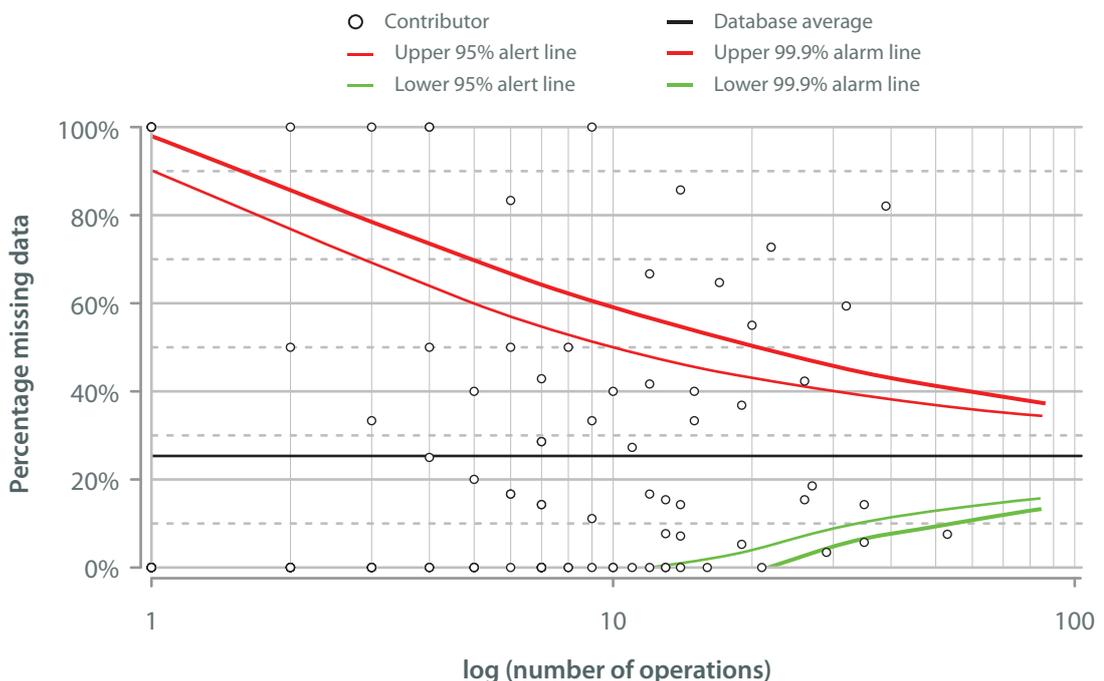
As with pre-operative laryngoscopy, there appears to be no consensus on post-operative assessment of vocal cord function, with variation in laryngoscopy rates between 0-100%.

Surgery for thyroid disease

First-time thyroid surgery: Missing post-operative laryngoscopy data (n=8,508)



Redo thyroid surgery: Missing post-operative laryngoscopy data (n=955)

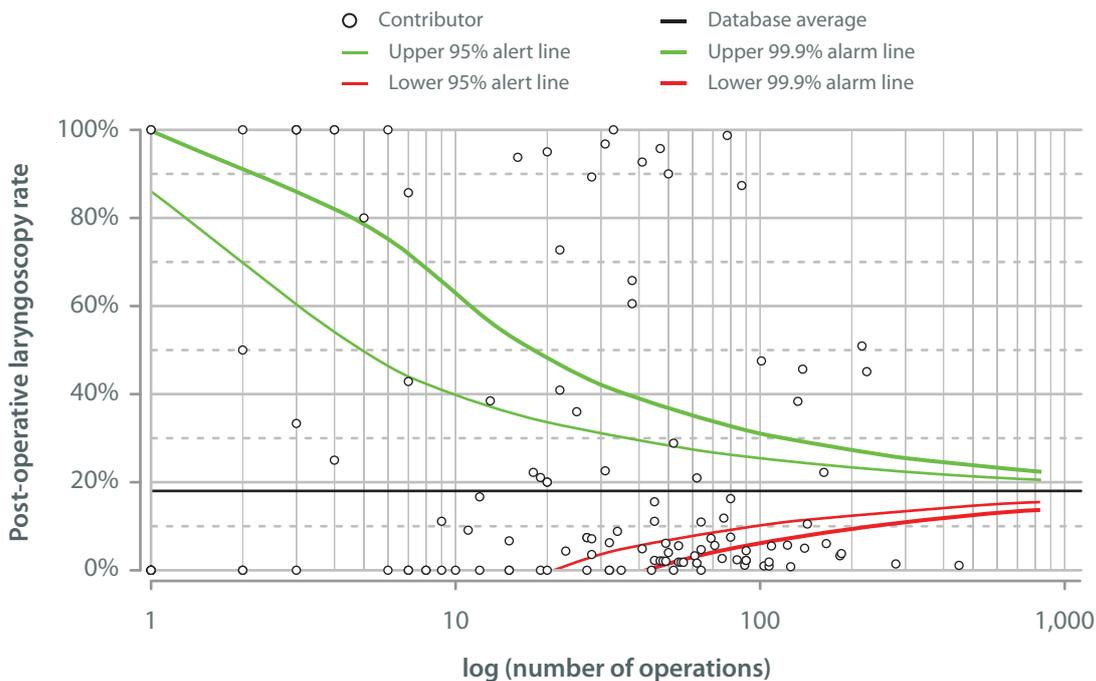




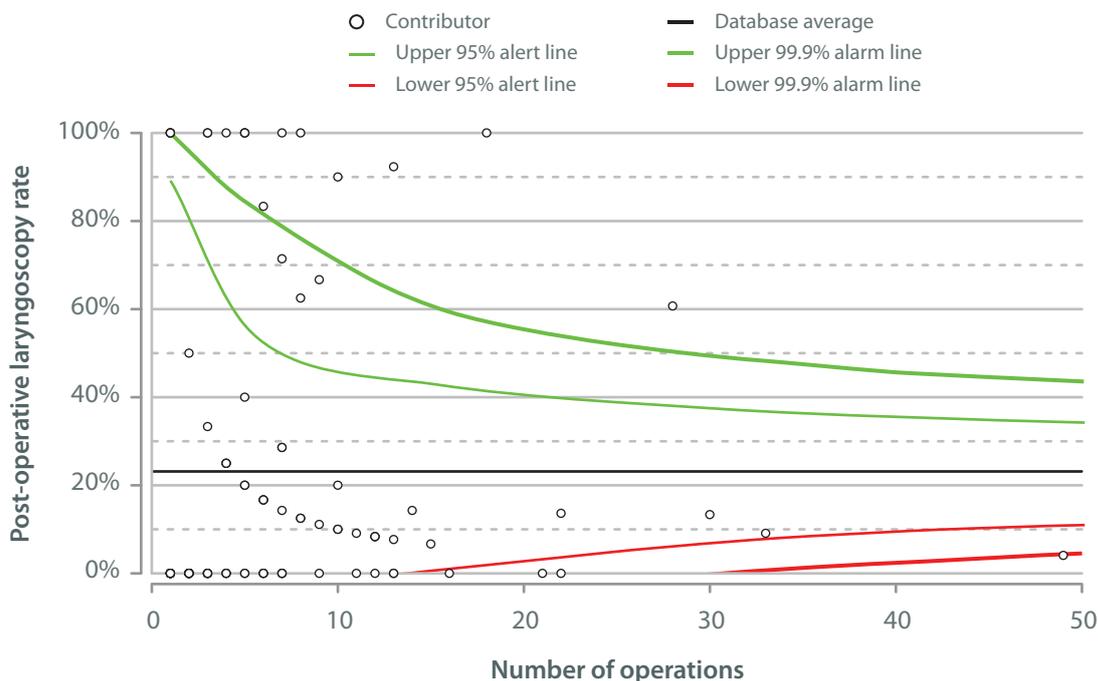
When recorded, mean rates of post-op laryngoscopy are <20% overall, and are no higher even for re-operative surgery.

Most members arrange post-operative laryngoscopy in only a small number of cases (probably only patients with symptomatic voice change); some do so selectively, but in the majority of cases; and a very few members clearly arrange post-operative cord checks routinely.

First-time thyroid surgery: Post-operative laryngoscopy rates (n=6,524)



Redo thyroid surgery: Post-operative laryngoscopy rates (n=713)

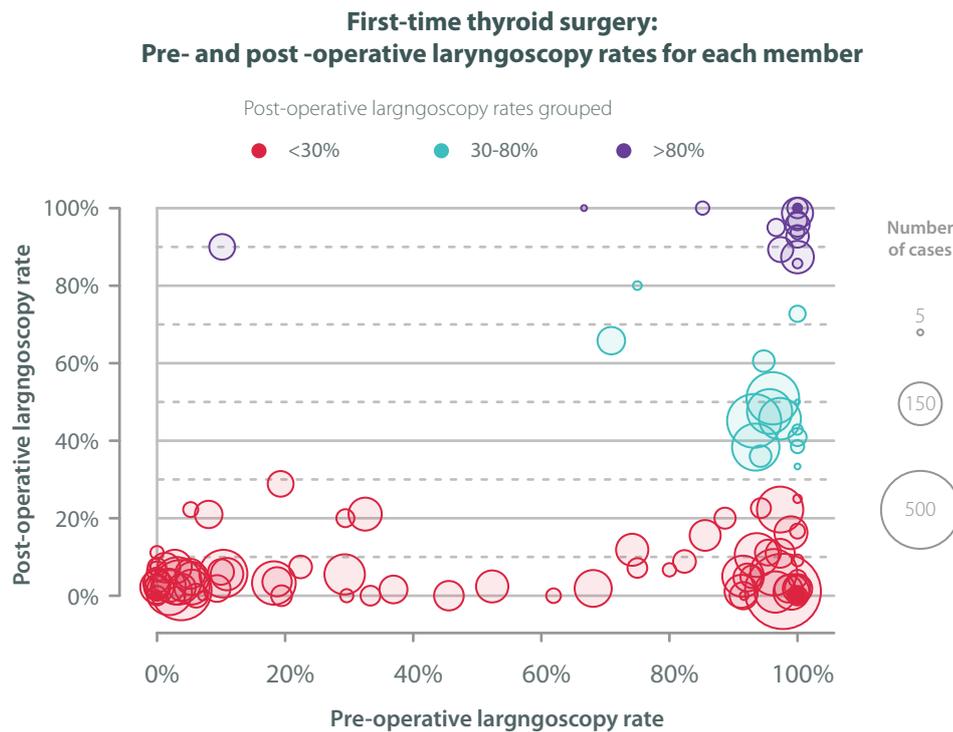




The following chart combines the reported rates of both pre- and post-operative laryngoscopy by member, and clearly demonstrates the division of the membership by policies for routine or selective assessments of vocal cord function at both time intervals.

These observations together raise serious doubts as to the accuracy of any estimates of recurrent laryngeal nerve injury, and of any comparisons of nerve palsy rates between patient groups or surgeons. This is compounded by the high rate of missing data on recurrent nerve palsy rate itself (detailed below).

If data from the audit are to be used for national benchmarking purposes, urgent attention to these issues will be necessary.



The reported incidence of RLN palsy is clearly influenced by these policies (for performance of post-operative laryngoscopy), as follows:

RLN palsy rates (reported) by rate of performance of post-operative laryngoscopy:

- <30% post-operative laryngoscopy gives a 1.7% RLN palsy rate (n=3,496; 95% CI: 1.3-2.2%).
- 30-80% 2.5% (n=565; 95% CI: 1.4-4.2%).
- >80% 4.2% (n=309; 95% CI: 2.4-7.3%).



Comment on the laryngoscopy and RLN palsy data

Voice change due to recurrent laryngeal nerve injury is arguably the most significant longer-term complication of thyroid surgery, with potential serious impact on quality of life.

It is therefore evident that RLN palsy rate should be an important audit outcome measure. However, this report highlights some difficulties in obtaining truly reliable estimates of this rate, particularly when comparing outcome between surgeons, such that it would be inappropriate to publish funnel plots of the RLN palsy rates currently reported. These difficulties in summary are:

- A relatively high rate of missing data for both post-operative laryngoscopy and RLN palsy data fields.
- Large variation in the use of laryngoscopy both pre- and post-operatively, this variation clearly influencing the reported rate of RLN palsy.

The issue of routine post-operative laryngoscopy was debated at a *consensus statement* session at the last Annual Meeting of the BAETS in 2011. The resulting consensus statement supported routine assessment of vocal cord function after thyroid surgery.

Such routine assessment would certainly facilitate more accurate measurement of RLN palsy rates, and more reliably allow comparison between members with respect to this outcome measure. From the perspective of this audit, therefore, such a policy should be supported.



Outcomes for first-time operations

Overview of post-operative events

Complication rates (with 95% confidence intervals) have remained relatively stable over time:

Surgery for thyroid disease

	2006-2007	2008-2009	2010-2011
Immediate post-operative outcomes			
Mortality	0.19% (0.08-0.41%)	0.19% (0.09-0.37%)	0.14% (0.07-0.29%)
Haemorrhage	1.1% (0.8-1.5%)	1.2% (1.0-1.6%)	1.0% (0.8-1.4%)
Any post-operative complication	3.0% (2.5-3.6%)	3.4% (2.9-4.0%)	3.3% (2.9-3.8%)
Hypocalcaemia	14.2% (13.1-15.3%)	11.7% (10.8-12.6%)	10.8% (10.1-11.7%)
Outcomes at follow up			
New RLN palsy	2.0% (1.55-2.59%)	1.7% (1.3-2.2%)	1.8% (1.4-2.5%)
Related readmission	2.5% (2.0-3.1%)	2.3% (1.9-2.8%)	2.3% (1.9-2.7%)
Voice change	5.6% (4.8-6.4%)	5.6% (4.9-6.3%)	6.1% (5.4-6.8%)
Calcium supplements	7.7% (6.8-8.7%)	6.5% (5.8-7.3%)	6.1% (5.4-6.8%)
T3/T4	52.1% (50.4-53.8%)	50.8% (49.3-52.3%)	48.0% (46.7-49.4%)

Mortality after thyroid surgery is reassuringly low, due partly to the nature of the surgery and partly to the patients' relatively young age compared to other types of surgery. Nonetheless, in looking at the data in more detail, it is apparent that 4 of the deaths occurred in patients in their 20s and 30s.

The rates of unspecified (missing) data vary considerably between outcome data fields. Follow-up data remain less complete than those outcomes specified at discharge, probably due to the need for members to revisit the database after the patient has been seen for follow-up and make a separate data entry. Even for outcome at discharge, rates of missing data range from 7.3-9.0%.

The commonest complication immediately after total thyroidectomy is hypocalcaemia.

Hypocalcaemia after lobectomy alone is largely accounted for by completion thyroidectomies.

The need for ongoing calcium/Vitamin D at follow-up has slightly reduced over the years. This may partly reflect the change in definition of this data field, to clarify the outcome as *requirement for calcium/vitamin D supplements to maintain normocalcaemia at 6 months*. Previously, use of such supplements for other reasons would have been included, plus outcome could have been recorded at an earlier interval post-operatively.

Recurrent laryngeal nerve injury rates are also stable over time, though as noted above, the accuracy of these estimates is uncertain.

Those cases having total thyroidectomy but not receiving T3/4 might represent a data entry problem, while the figures for T3/T4 usage after lobectomy refer to the early post-operative period, rather than representing reliable estimates of long-term hypothyroidism.



First-time thyroid surgery: post-operative events for **all cases**; financial years 2010 & 2011

			Event incidence			
			No	Yes	Unspecified	Rate (95% CI)
Timing of event	Post-op	Mortality	5,633	8	538	0.14% (0.07-0.29%)
		Re-operation for haemorrhage	5,670	60	449	1.0% (0.8-1.4%)
		Post-operative complications	5,433	187	559	3.3% (2.9-3.8%)
		Hypocalcaemia	5,074	617	488	10.8% (10.1-11.7%)
	Follow up	New proven RLN palsy	2,562	48	3,569	1.8% (1.4-2.5%)
		Related readmission	4,963	115	1,101	2.3% (1.9-2.7%)
		Voice change	4,756	307	1,116	6.1% (5.4-6.8%)
		Calcium supplements	4,610	297	1,272	6.1% (5.4-6.8%)
		T3/T4	2,615	2,418	1,146	48.0% (46.7-49.4%)

First-time thyroid surgery: post-operative events after **total thyroidectomy**; financial years 2010 & 2011

			Event incidence			
			No	Yes	Unspecified	Rate (95% CI)
Timing of event	Post-op	Mortality	1,967	2	193	0.10% (0.02-0.41%)
		Re-operation for haemorrhage	1,977	26	159	1.3% (0.9-1.9%)
		Post-operative complications	1,863	90	209	4.6% (3.7-5.7%)
		Hypocalcaemia	1,489	495	178	24.9% (23.1-26.9%)
	Follow up	New proven RLN palsy	846	20	1,296	2.3% (1.5-3.6%)
		Related readmission	1,685	44	433	2.5% (1.9-3.4%)
		Voice change	1,586	135	441	7.8% (6.6-9.2%)
		Calcium supplements	1,458	201	503	12.1% (10.6-13.8%)
		T3/T4	70	1,650	442	95.9% (94.9-96.8%)

First-time thyroid surgery: post-operative events after **lobectomy**; financial years 2010 & 2011

			Event incidence			
			No	Yes	Unspecified	Rate (95% CI)
Timing of event	Post-op	Mortality	2,850	4	266	0.14% (0.04-0.38%)
		Re-operation for haemorrhage	2,876	25	219	0.9% (0.6-1.3%)
		Post-operative complications	2,787	72	261	2.5% (2.0-3.2%)
		Hypocalcaemia	2,850	36	234	1.2% (0.9-1.7%)
	Follow up	New proven RLN palsy	1,321	17	1,782	1.3% (0.8-2.1%)
		Related readmission	2,542	58	520	2.2% (1.7-2.9%)
		Voice change	2,477	117	526	4.5% (3.8-5.4%)
		Calcium supplements	2,473	50	597	2.0% (1.5-2.6%)
		T3/T4	2,187	381	552	14.8% (13.5-16.3%)



Hypocalcaemia

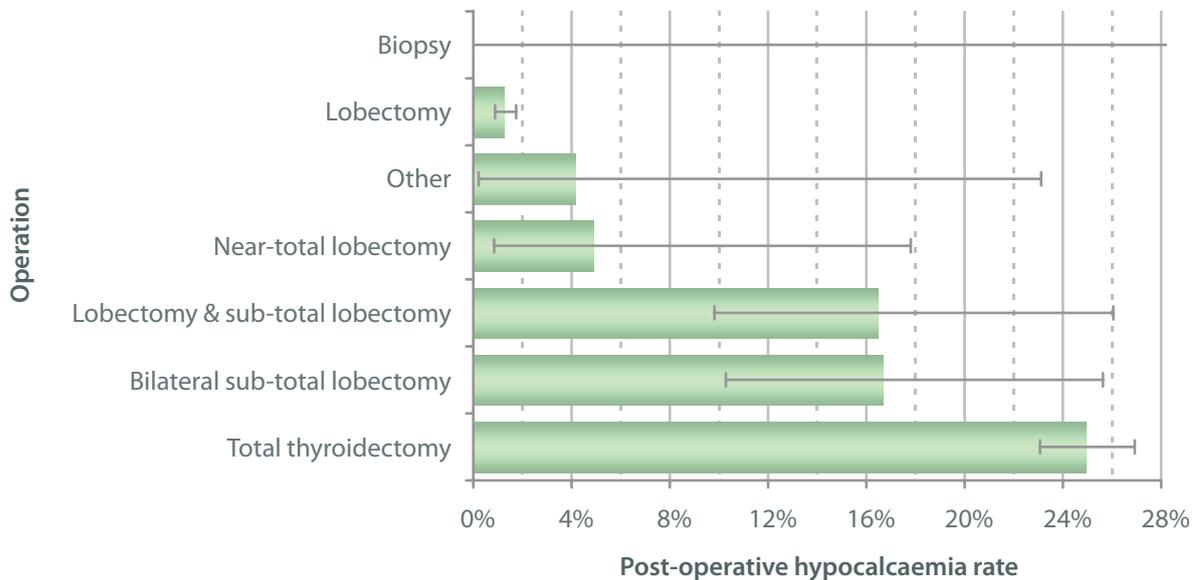
Hypocalcaemia and type of operation

With slightly higher numbers compared to the 2009 report, the trend for greater early hypocalcaemia after total thyroidectomy compared to less-than-total bilateral resections is more obvious. As detailed below, however, this does not translate into a higher rate of late hypocalcaemia / need for calcium / vitamin D supplements.

First-time thyroid surgery: post-operative hypocalcaemia and operation; financial years 2010 & 2011

		Post-operative hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Operation performed	Total thyroidectomy	1,489	495	178	24.9% (23.1-26.9%)
	Lobectomy & sub-total thyroidectomy	76	15	4	16.5% (9.8-26.1%)
	Lobectomy	2,850	36	234	1.2% (0.9-1.7%)
	Bilateral sub-total lobectomy	85	17	4	16.7% (10.3-25.6%)
	Near-total lobectomy	39	2	0	4.9% (0.8-17.8%)
	Biopsy	9	0	1	0.0% (0.0-28.3%)
	Other	23	1	2	4.2% (0.2-23.1%)
	Unspecified	503	51	65	9.2% (7.0-12.0%)
	All	5,074	617	488	10.8% (10.1-11.7%)

First-time thyroid surgery: Post-operative hypocalcaemia and operation; financial years 2010 & 2011 (n=5,137)

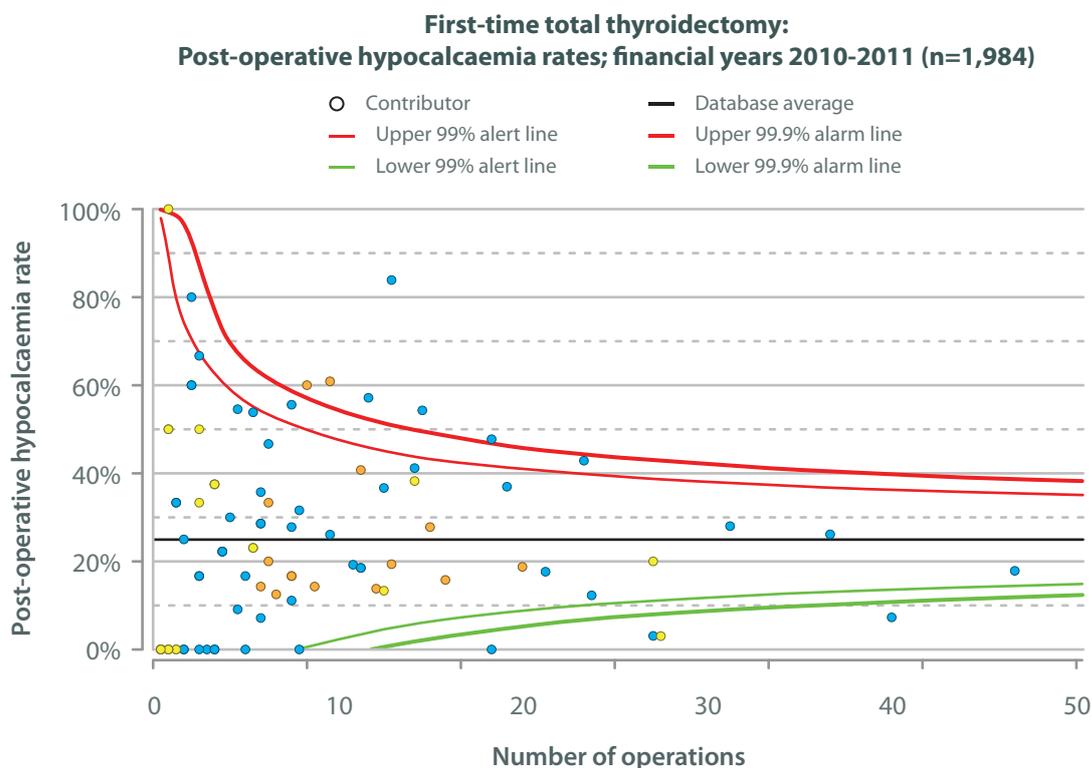




Hypocalcaemia and workload

Despite the *tighter* definition for post-operative hypocalcaemia, there remains considerable variation between members with respect to this outcome measure. Six members fall outside the upper alarm line, while four fall below the lower alarm line, demonstrating very low rates of hypocalcaemia after total thyroidectomy.

The results have been stratified by the surgeon's rate of missing data for this outcome field. There is no apparent systematic effect of this stratification on the reported outcome rates. However, for one of those members with a very low reported hypocalcaemia rate, data for this outcome were missing in over 20% of cases. The inclusion of missing outcomes for members falling outside the alarm lines might easily lead to a significant change in the appearance of these funnel plots.



1. Orange <5% missing
2. Blue 5-20% missing
3. Yellow >20% missing



Late hypocalcaemia

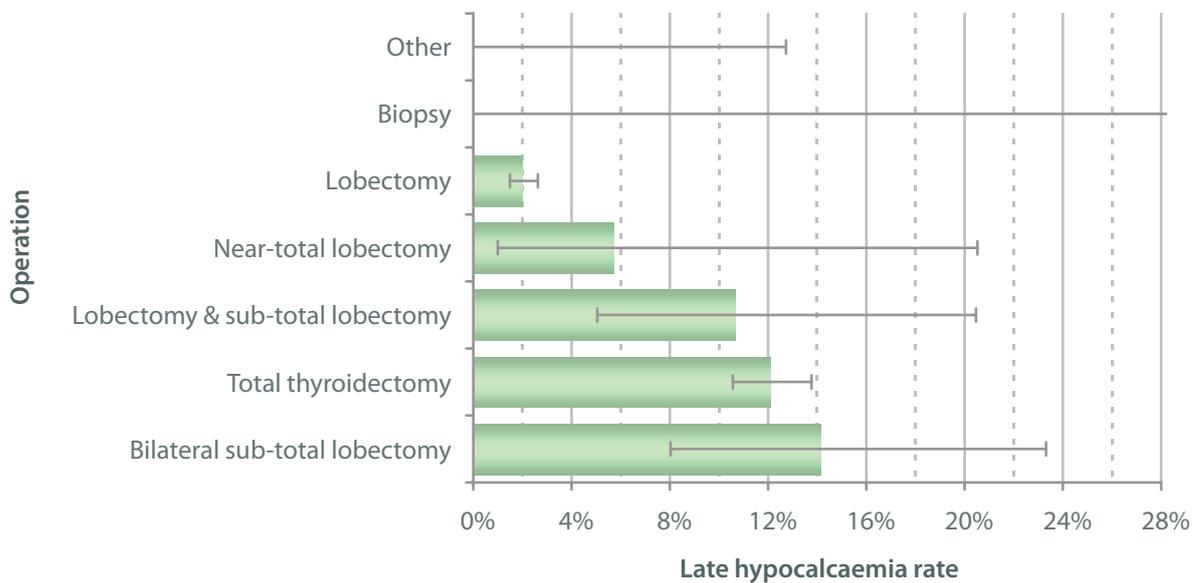
Late hypocalcaemia and type of operation

There is little difference between total thyroidectomy and lesser bilateral procedures with respect to the rate of late hypocalcaemia.

First-time thyroid surgery: late hypocalcaemia and operation; financial years 2010 & 2011

		Late hypocalcaemia			
		No	Yes	Unspecified	Rate (95% CI)
Operation performed	Total thyroidectomy	1,456	200	501	12.1% (10.6-13.8%)
	Lobectomy & sub-total thyroidectomy	67	8	20	10.7% (5.0-20.5%)
	Lobectomy	2,471	50	596	2.0% (1.5-2.6%)
	Bilateral sub-total lobectomy	79	13	14	14.1% (8.0-23.3%)
	Near-total lobectomy	33	2	6	5.7% (1.0-20.5%)
	Biopsy	8	0	2	0.0% (0.0-31.2%)
	Other	22	0	4	0.0% (0.0-12.7%)
	Unspecified	470	23	126	4.7% (3.0-7.0%)
	All	4,606	296	1,269	6.0% (5.4-6.8%)

First-time thyroid surgery: Late hypocalcaemia and operation; financial years 2010 & 2011 (n=4,409)



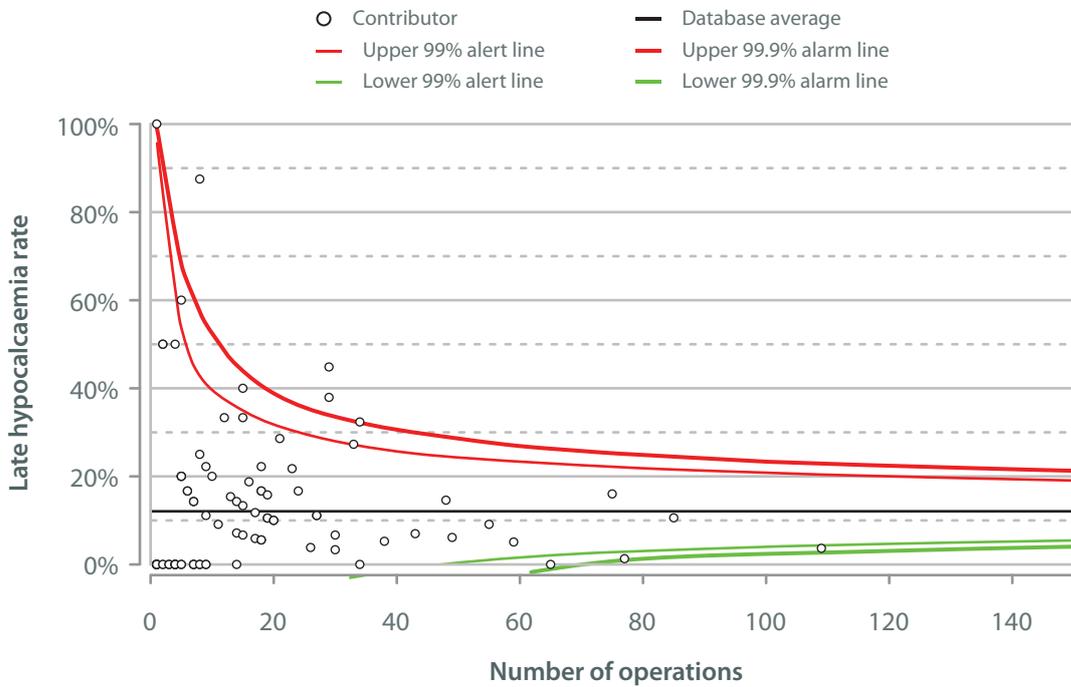


Late hypocalcaemia and workload

There is considerable variation between members with respect to late hypocalcaemia rates. This may reflect:

- Data quality issues, particularly important for those individuals close to / outside alarm lines who also have higher rates of missing data.
- Differences in operative skill and ability to preserve parathyroid function.
- Differences in indications for surgery / case mix.
- Differences in departmental policies for weaning patients off calcium / vitamin D supplements.

**First-time total thyroidectomy:
Late hypocalcaemia rates; financial years 2010-2011 (n=1,656)**





Outcomes for redo operations

Overview of post-operative events

As expected, and consistent with previous reports, the stated rate of new RLN palsy is much higher for re-operative surgery on the same side as a previous dissection (relative risk 4.8).

The majority of re-operations in the database are completion lobectomies. Complication rates for these cases are therefore an amalgam between those for first-time total thyroidectomy and first-time lobectomy:

For hypocalcaemia, transient parathyroid compromise may be less frequent after completion thyroidectomy than after total thyroidectomy, as any preserved glands on the opposite side of the neck will not be disturbed anew. Late hypocalcaemia, however, will be similar to first-time total thyroidectomy, as this depends on the sum preservation of parathyroid function over both procedures.

For RLN palsy, the incidence will depend on the proportion carried out ipsilateral to any previous surgery. This explains why the rate for re-do total thyroidectomy is very high, and why that for lobectomy is higher than first-time lobectomy alone.

Redo thyroid surgery: post-operative events; financial years 2010 & 2011

			Event incidence			
			No	Yes	Unspecified	Rate (95% CI)
Timing of event	Post-op	Mortality	605	1	76	0.2% (0.0-1.1%)
		Re-operation for haemorrhage	603	8	71	1.3% (0.6-2.7%)
		Post-operative complications	576	20	86	3.4% (2.1-5.2%)
		Hypocalcaemia	527	80	75	13.2% (10.6-16.2%)
	Follow up	New proven RLN palsy	257	8	417	3.0% (1.4-6.1%)
		Related readmission	530	16	136	2.9% (1.7-4.8%)
		Voice change	503	42	137	7.7% (5.7-10.4%)
		Calcium supplements	459	62	161	11.9% (9.3-15.1%)
		T3/T4	59	486	137	89.2% (86.2-91.6%)

Redo thyroid surgery: post-operative events after **total thyroidectomy**; financial years 2010 & 2011

			Event incidence			
			No	Yes	Unspecified	Rate (95% CI)
Timing of event	Post-op	Mortality	59		12	0.0% (0.0-5.0%)
		Re-operation for haemorrhage	59	1	11	1.7% (0.1-10.1%)
		Post-operative complications	56	1	14	1.8% (0.1-10.6%)
		Hypocalcaemia	45	15	11	25.0% (15.1-38.1%)
	Follow up	New proven RLN palsy	27	3	41	10.0% (2.6-27.7%)
		Related readmission	51	2	18	3.8% (0.7-14.1%)
		Voice change	49	5	17	9.3% (3.5-21.1%)
		Calcium supplements	37	13	21	26.0% (15.1-40.6%)
		T3/T4	3	50	18	94.3% (83.4-98.5%)



Redo thyroid surgery: post-operative events after **lobectomy**; financial years 2010 & 2011

		Event incidence				
		No	Yes	Unspecified	Rate (95% CI)	
Timing of event	Post-op	Mortality	462	1	54	0.2% (0.0-1.4%)
		Re-operation for haemorrhage	460	6	51	1.3% (0.5-2.9%)
		Post-operative complications	440	16	61	3.5% (2.1-5.8%)
		Hypocalcaemia	403	60	54	13.0% (10.1-16.4%)
	Follow up	New proven RLN palsy	198	5	314	2.5% (0.9-6.0%)
		Related readmission	410	12	95	2.8% (1.5-5.1%)
		Voice change	387	32	98	7.6% (5.4-10.7%)
		Calcium supplements	364	41	112	10.1% (7.4-13.6%)
		T3/T4	53	368	96	87.4% (83.8-90.4%)



Multi-variate analyses of factors affecting outcomes after thyroid surgery

Multi-variate analysis of possible predictive factors affecting complication rates of thyroid surgery has been included in this report for the first time. The reasons to consider doing this were:

1. Sufficient data have now been accrued to allow statistically valid sub-group analyses and the power to detect meaningful interactions between variables.
2. Single variables which affect outcome have become clear over the years, but there is evidence of significant interaction between them, so that the importance of any one variable may be modulated by others. It seems important to be able to dissect out these interactions.
3. In the longer term it would be useful to produce models of risk stratification and risk adjustment, which might allow for improved benchmarking and comparison between surgeons. This is particularly relevant if these audit data are eventually to be utilised for revalidation purposes.

The analyses presented here are an early step along this pathway.

The extent of missing data is, however, a significant limitation in these analyses. For this reason, the only outcomes examined were:

- Re-exploration for haemorrhage.
- Early hypocalcaemia.
- Calcium /Vitamin D supplements at follow-up (*late hypocalcaemia*).

Data on RLN palsy are not sufficiently robust to allow for such analysis at present.

Bleeding

Data on all cases entered into the database with operations dated prior to April 2011 were extracted, with the following exclusions:

- age <0 years; age >100 years (likely errors in data entry).
- missing gender.
- left- and right-sided thyroid procedure data missing.

This leaves 16,538 operations, of which 1,037 have no data on *Re-operation for haemorrhage*. The overall rate of re-operations for bleeding was 1.20% (n=15,501; 95% CI: 1.04-1.39%; odds=0.012).

Potential predictive factors investigated include:

- age.
- gender.
- pathology (Graves', multi-nodular goitre, cancer).
- bilateral *versus* unilateral surgery.
- operation sequence (first-time surgery, redo surgery).
- any lymph node dissection.

For the age variable, the median for patients who experienced no bleeding was 48 years (IQR: 37-60 years) *versus* 55 years (IQR: 40-66 years) for patients who did have a re-operation for haemorrhage. A Mann-Whitney U test showed significance at p<0.001.



Multiple logistic regression is a method of multi-variate analysis which examines the relative contributions of various potential predictor variables upon a single binary outcome measure (e.g., haemorrhage or no haemorrhage). Predictor variables may themselves be either binary (e.g., female / male) or continuous (e.g., age).

Advantages to this type of analysis are:

Variables which are *significant* in uni-variate analysis may become less so in multiple logistic regression, if they are associated with other, stronger predictors of outcome. Theoretically, this allows identification of the most important factors predicting outcome.

It allows the probability of a particular outcome to be predicted from a given combination of potential predictor variables, which may allow for outcome adjustment by case-mix.

The calculation method is as follows: for any binary outcome (e.g., *haemorrhage or no haemorrhage*) the influence of potential predictor variables can be combined, so that if the probability of the outcome = q (calculated as r / n), then:

$$\log \left(\frac{q}{1-q} \right) = C + \{(\text{estimate a}) \times (\text{proportion with predictor variable a})\} + \{(\text{estimate b}) \times (\text{continuous predictor variable b})\} \dots \text{etc.}$$

where C is a constant.

In our tables, O denotes the odds on an event, and OR the odds ratio; SE is the standard error; t is the standard normal deviate; p test probability

So, for example, using the second logistic regression model for haemorrhage (see page 108), a surgeon whose cases had mean age 48 years, with 35% having bilateral surgery, the predicted rate of haemorrhage (q) could be estimated as follows:

$$\begin{aligned} \log \left(\frac{q}{1-q} \right) &= -5.81 + (0.023 \times 48) + (0.488 \times 0.35) \\ &= -4.535 \end{aligned}$$

so that:

$$\begin{aligned} q &= \frac{e^{-4.535}}{(1 + e^{-4.535})} = 0.0106 \\ &\equiv 1.06\% \end{aligned}$$



Re-operation for haemorrhage after thyroid surgery: analysis by potential predictive factors

Surgery for thyroid disease

		Bleeding				
		r	n	q	O	OR (95% CI)
Potential predictive factors	All	186	15,501	0.0120		
	Female	144	12,783	0.0113	0.0114	
	Male	42	2,718	0.0155	0.0157	1.38 (0.97-1.95)
	Not Graves'	154	13,336	0.0115	0.0117	
	Graves'	32	2,165	0.0148	0.0150	1.28 (0.87-1.88)
	Not multi-nodular goitre	131	10,504	0.0125	0.0125	
	Multi-nodular goitre	55	4,997	0.0110	0.0110	0.88 (0.64-1.21)
	Not cancer	161	12,964	0.0124	0.0126	
	Cancer	25	2,537	0.0099	0.0100	0.79 (0.52-1.21)
	First-time surgery	166	13,796	0.0120	0.0122	
	Redo surgery	19	1,557	0.0122	0.0124	1.02 (0.63-1.64)
	Unilateral (all)	90	9,213	0.0098	0.0099	
	Bilateral (all)	96	6,288	0.0153	0.0155	1.57 (1.17-2.09)
	Bilateral sub-total	10	408	0.0245	0.0251	2.54 (1.31-4.91)
	Total	77	5,488	0.0140	0.0142	1.43 (1.06-1.95)
	No LN dissection	174	14,044	0.0124	0.0125	
	LN dissection	12	1,457	0.0082	0.0082	0.66 (0.36-1.18)



Re-operation for haemorrhage after thyroid surgery: multiple logistic regression model #1

		Statistical data				
		Estimate (95% CL)	SE	t	p	OR (95% CL)
Predictors	Constant	-5.91 (-6.48 to -5.32)	0.295	-20.0	0.000	0.003 (0.0015-0.0048)
	Gender	0.11 (-0.06 to 0.64)	0.178	1.61	0.108	1.332 (0.938-1.890)
	Age	0.024 (0.015 to 0.034)	0.00493	4.91	9.24 × 10 ⁻⁷	1.025 (1.015-1.034)
	Graves'	0.234 (-0.224 to 0.069)	0.233	1.00	0.316	1.264 (0.780-1.999)
	Cancer	-0.063 (-0.557 to 0.431)	0.252	-0.249	0.803	0.939 (0.573-1.539)
	Laterality	0.440 (0.115 to 0.764)	0.166	2.65	0.008	1.55 (1.12-2.15)
	Node dissection	-0.459 (-1.126 to 0.208)	0.340	-1.35	0.178	0.632 (0.324-43565)

Final loss: 987.3; $\chi^2=40.49$ ($p<0.001$); with all factors included, only age and laterality (*i.e.*, bilateral versus unilateral) remain significant. The regression model containing just these two factors is as below:

Re-operation for haemorrhage after thyroid surgery: multiple logistic regression model #2

		Statistical data				
		Estimate (95% CL)	SE	t	p	OR (95% CL)
Predictors	Constant	-5.81 (-6.35 to -5.27)	0.275	-21.1	0.00	0.0030 (0.0017-0.051)
	Age	0.023 (0.014 to 0.032)	4.64 × 10 ⁻³	4.93	8.48 × 10 ⁻⁷	1.023 (1.014-1.032)
	Laterality	0.488 (0.199 to 0.778)	0.148	3.30	9.53 × 10 ⁻⁴	1.630 (1.220-2.177)

Final loss: 990.7; $\chi^2=33.69$ ($p<0.001$)



Hypocalcaemia

Data on all cases entered into the database with operations dated prior to April 2011 where the laterality was *bilateral* were extracted, with the following exclusions:

- age <0 years; age >100 years.
- missing gender.

This leaves 6,676 operations, of which 457 have no data on *Hypocalcaemia*. The overall rate of hypocalcaemia was 26.6% (n=6,219; 95% CI: 25.5-27.7%; odds=0.36).

Potential predictive factors investigated include:

- age.
- gender.
- pathology (Graves', multi-nodular goitre, cancer).
- operation sequence (first-time surgery, redo surgery).
- level 6 node dissection.

For the age variable, the median for patients who experienced no hypocalcaemia was 48 years (IQR: 38-60 years) versus 45 years (IQR: 35-58 years) for patients who did have hypocalcaemia. A Mann-Whitney U test showed significance at p<0.001.

The trend to higher hypocalcaemia rates for cancer cases are very largely due to association with level 6 dissection. This is highlighted if cancer: is excluded from the model, retaining level 6 dissection.

Hypocalcaemia after bilateral thyroid surgery: analysis by potential predictive factors

		Hypocalcaemia				
		r	n	q	O	OR (95% CI)
Potential predictive factors	All	1,655	6,219	0.266		
	Female	1,379	5,077	0.272	0.373	
	Male	276	1,142	0.242	0.319	0.86 (0.74-0.99)
	Multi-nodular goitre	399	1,807	0.221	0.283	
	Graves'	600	2,088	0.287	0.404	1.43 (1.23-1.65)
	Cancer	315	939	0.335	0.505	1.78 (1.50-2.13)
	No LN dissection	1,234	4,837	0.255	0.342	
	LN dissection	271	720	0.376	0.604	1.77 (1.50-2.08)
	First-time surgery	1,590	5,967	0.266	0.363	
	Redo surgery	52	184	0.283	0.394	1.09 (0.78-1.50)



Hypocalcaemia after bilateral thyroid surgery: multiple logistic regression model #1

		Statistical data				
		Estimate (95% CL)	SE	t	p	OR (95% CL)
Predictors	Constant	-0.662 (-0.885 to -0.516)	0.113	-5.83	5.75×10 ⁻⁹	0.516 (0.413-0.644)
	Gender	-0.237 (-0.396 to -0.077)	0.0814	2.91	3.65×10 ⁻³	0.789 (0.673-0.926)
	Age	0.010 (-0.014 to -0.006)	0.00203	-4.85	1.24×10 ⁻⁶	0.990 (0.986-0.994)
	Graves'	0.183 (0.040 to 0.327)	0.0732	2.50	0.0122	1.20 (1.04-1.38)
	Cancer	0.197 (-0.028 to 0.421)	0.115	1.71	0.0861	1.22 (0.97-1.52)
	Node dissection	0.560 (0.321 to 0.799)	0.122	4.59	0.0000	1.75 (1.38-2.22)
Final loss: 3196.2; $\chi^2=99.14$ (p<0.001)						

Hypocalcaemia after bilateral thyroid surgery: multiple logistic regression model #2

		Statistical data				
		Estimate (95% CL)	SE	t	p	OR (95% CL)
Predictors	Constant	-0.638 (-0.859 to -0.417)	0.113	-5.66	1.60×10 ⁻⁸	0.528 (0.423-0.659)
	Gender	-0.230 (-0.390 to -0.071)	0.081	-2.84	4.59×10 ⁻³	0.794 (0.677-0.931)
	Age	-0.010 (-0.014 to -0.006)	0.002	-4.88	1.07×10 ⁻⁶	0.990 (0.986-0.994)
	Graves'	0.161 (0.020 to 0.302)	0.072	2.23	0.027	1.17 (1.02-1.35)
	Node dissection	0.700 (0.524 to 0.877)	0.090	7.77	9.13×10 ⁻¹⁵	2.01 (1.69-2.40)
	Final loss: 3197.6; $\chi^2=96.23$ (p<0.001)					



Late hypocalcaemia

Data on all cases entered into the database with operations dated prior to April 2011 where the laterality was *bilateral* were extracted, with the following exclusions:

- age <0 years; age >100 years.
- missing gender.

This leaves 6,676 operations, of which 1,198 have no data on *Calcium/vitamin D supplements at 6 months*. The overall rate of calcium / vitamin D supplements at 6 months was 13.6% (n=5,478; 95% CI: 12.7-14.6%; odds=0.16).

Potential predictive factors investigated include:

- age.
- gender.
- pathology (Graves', multi-nodular goitre, cancer).
- operation sequence (first-time surgery, redo surgery).
- level 6 node dissection.

For the age variable, the median for patients who had no supplements was 46 years (IQR: 36-60 years) *versus* 45 years (IQR: 35-60 years) for patients who did receive supplements (Mann-Whitney U p=0.139).

Calcium / vitamin D supplements at 6 months after bilateral thyroid surgery: analysis by potential predictive factors

		Late hypocalcaemia				
		r	n	q	O	OR (95% CI)
Potential predictive factors	All	747	5,478	0.136		
	Female	622	4,495	0.138	0.161	
	Male	125	983	0.127	0.146	0.91 (0.74-1.11)
	Multi-nodular goitre	185	1,646	0.112	0.127	
	Graves'	233	1,867	0.125	0.143	1.13 (0.92-1.38)
	Cancer	174	810	0.215	0.274	2.16 (1.72-2.71)
	No LN dissection	532	4,316	0.123	0.141	
	LN dissection	141	593	0.238	0.312	2.21 (1.79-2.73)
	First-time surgery	707	5,259	0.134	0.155	
	Redo surgery	34	165	0.206	0.260	1.68 (1.14-2.47)

Calcium / vitamin D supplements at 6 months after bilateral thyroid surgery: multiple logistic regression model #1

		Statistical data				
		Estimate (95% CL)	SE	t	p	OR (95% CL)
Predictors	Constant	-1.75 (-2.05 to -1.44)	0.155	-11.3	4.99x10 ⁻²⁹	0.174 (0.129-0.236)
	Gender	-0.210 (-0.430 to 0.009)	0.112	-1.88	0.060	0.810 (0.651-1.009)
	Age	-0.005 (-0.010 to 0.001)	0.003	-1.74	0.081	0.995 (0.990-1.001)
	Graves'	0.030 (-0.172 to 0.232)	0.103	0.292	0.770	1.031 (0.842-1.262)
	Cancer	0.380 (0.090-0.669)	0.148	2.57	0.010	1.462 (1.095-1.952)
	Node dissection	0.564 (0.258 to 0.871)	0.157	3.61	0.0003	1.758 (1.294-2.390)
	Final loss: 1930.1; $\chi^2=63.55$ (p<0.001)					



Conclusions

Multi-variate analysis has allowed risk factors for certain outcome measures to be identified and quantified. These factors vary in importance depending upon the outcome measure considered, so that:

- Bleeding is largely affected by the extent of thyroidectomy (bilateral subtotal > total > lobectomy) and to a lesser effect by (increasing) age. This is consistent with a recent paper from an Austrian registry published in the British Journal of Surgery¹.
- Early hypocalcaemia is affected by Level 6 dissection, Graves' disease and to a lesser degree by (lower) age and (female) gender.
- But late hypocalcaemia is mostly dependent on cancer diagnosis and especially level 6 dissection.
- Inter-surgeon variation, however, still accounts for most of the residual variance. Ultimately, however, we can look to refining these factors to risk-adjust members' complication rates and re-plot funnel plots accordingly.

1. Promberger R *et al.* Risk factors for post-operative bleeding after thyroid surgery. *British Journal of Surgery*. 2012; **99**: 373-379.



Association

British



Surgery for parathyroid disease



Surgery for parathyroid disease

General information from the database

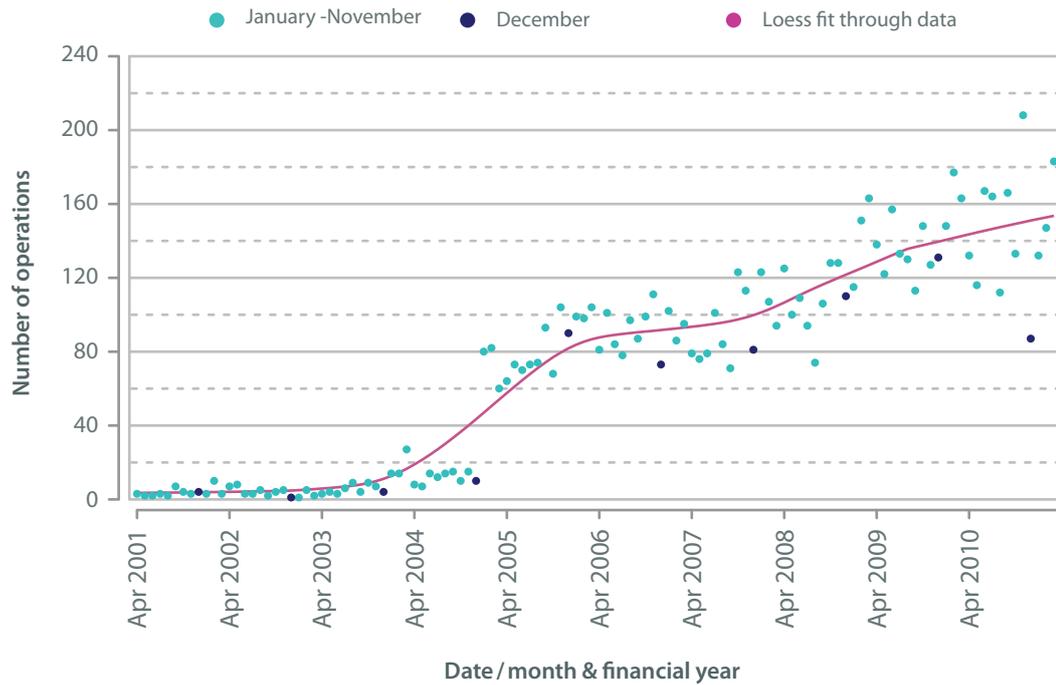
Number of members

The increased number of parathyroid cases reported over time parallels that seen for thyroid surgery.

There are now a total of 8,619 procedures recorded in the database; 110 members have contributed to this total.

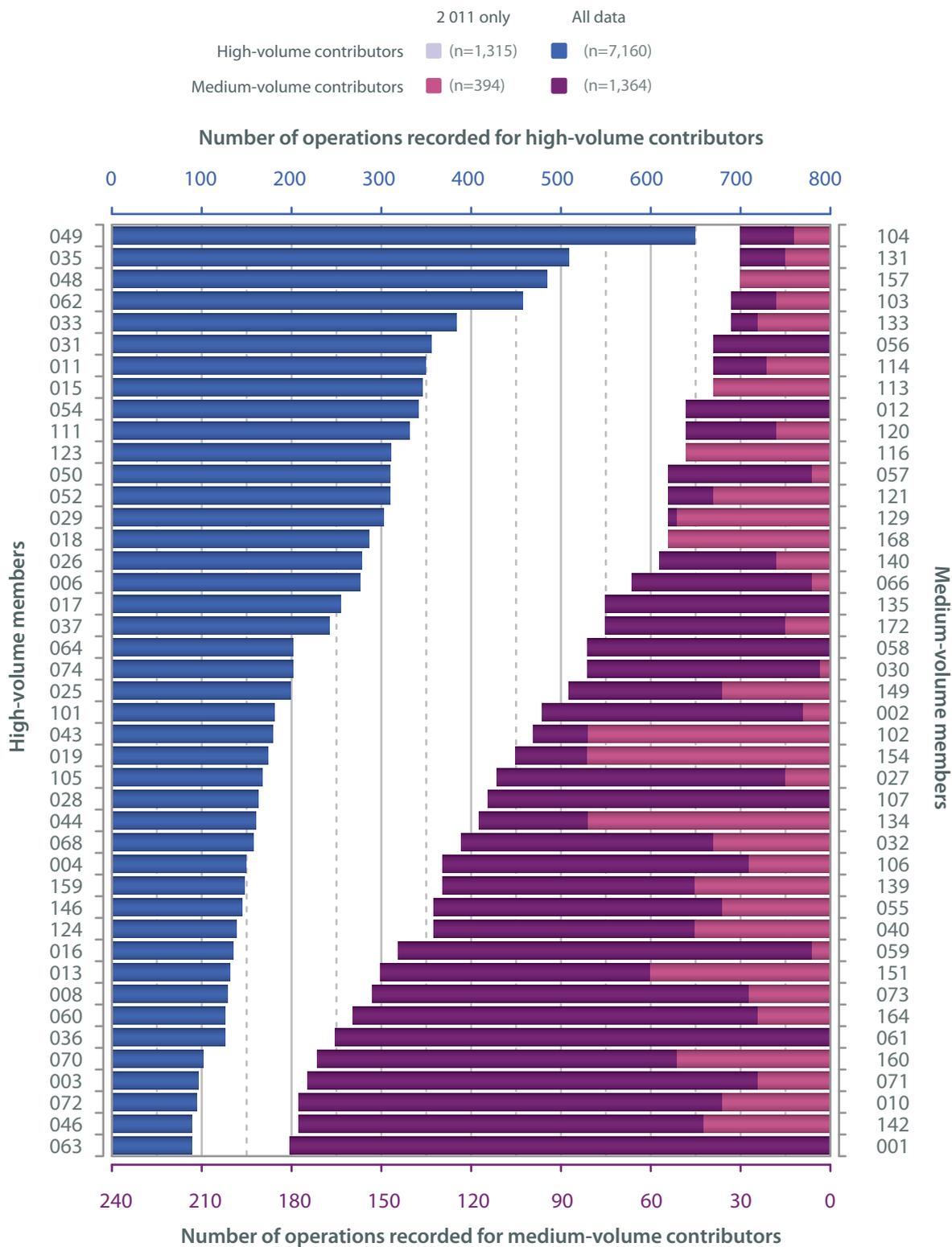
Surgery for parathyroid disease

The growth of the database (n=8,609 parathyroid cases)





Parathyroid surgery: number of operations reported by each member



Surgery for parathyroid disease

There are data from 24 lower-volume contributors not included in this chart, who submitted a total 95 cases (average = 4.0 cases per member).



Demographics and disease profile

Pathology

Pathology and age

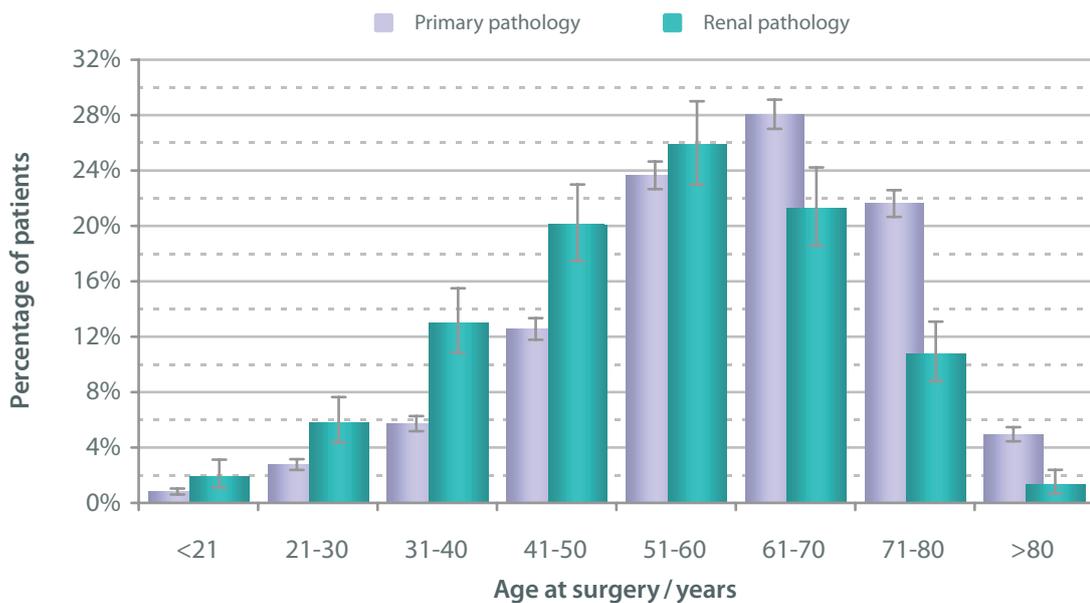
In the 2009 report it was highlighted that some members had recorded patients as having both primary and renal hyperparathyroidism (HPT). Since then, changes to the data entry system have made these two options mutually exclusive, aiding interpretation of the true underlying pathology.

The age profile for primary HPT is as expected, with 78% of patients being >50 years of age. The slightly younger age profile for renal HPT reflects the earlier onset of renal failure and dialysis.

Parathyroid surgery: age and pathology distributions

		Pathology			
		Primary	Renal	Unspecified	All
Age at surgery / years	<21	56	16	7	79
	21-30	194	49	17	260
	31-40	403	110	33	546
	41-50	887	170	81	1,138
	51-60	1,672	219	187	2,078
	61-70	1,984	180	203	2,367
	71-80	1,528	91	143	1,762
	>80	349	11	29	389
	Unspecified	0	0	0	0
	All	7,073	846	700	8,619

Parathyroid surgery: Age distribution and pathology (n=7,919)



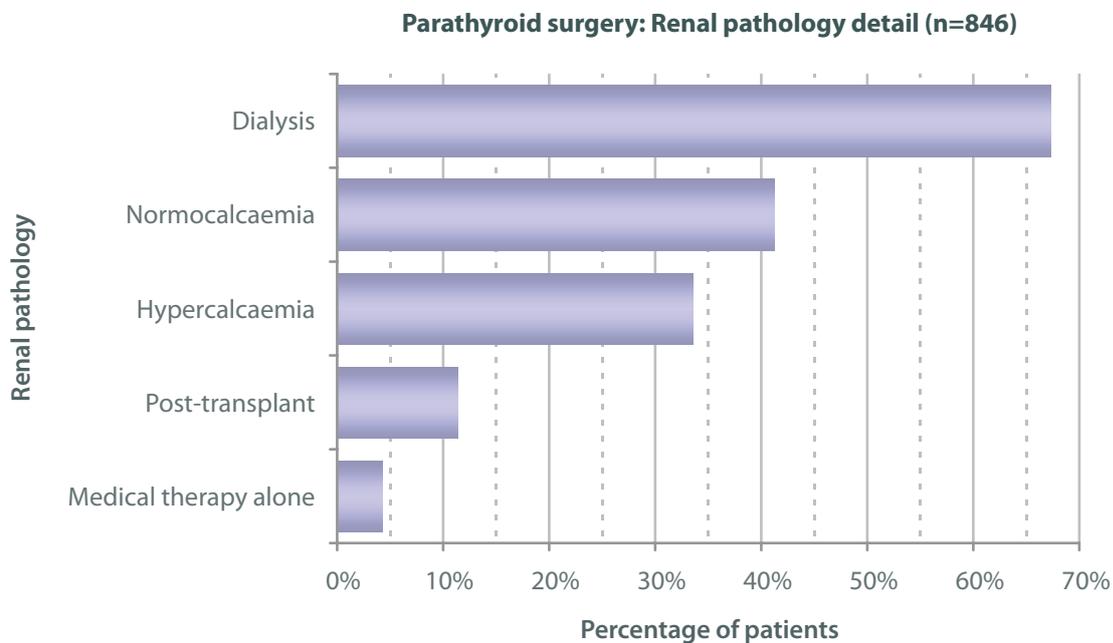


Renal pathology

As expected, the majority of patients undergoing surgery for renal HPT are on dialysis, with a slight predominance of normocalcaemic cases over those with hypercalcaemia.

Parathyroid surgery: renal pathology detail

		Data	
		Count	Proportion
Renal pathology	Normocalcaemia	349	41.3%
	Hypercalcaemia	284	33.6%
	Medical therapy alone	36	4.3%
	Dialysis	569	67.3%
	Post-transplant	96	11.3%
	Unspecified	0	
	All	846	





Investigations

Localisation techniques

An overview of localisation techniques used

The majority of patients now undergo pre-operative localisation studies prior to first-time surgery. For primary HPT the use of MIBI scanning has increased from around 68% of cases in 2004 to 90% in 2010; ultrasound from 55% to 83% over the same time-interval.

When performed, the positivity rate of each modality is:

- 69.8% for nuclear medicine.
- 59.2% for ultrasound.
- 51.4% for CT/MRI.
- 70.5% for venous sampling.
- 15.8% for PET.
- 84.2% for methylene blue.

The commonest combination of investigations is nuclear medicine & ultrasound.

CT/MRI is performed prior to first-time surgery in 5.1% of cases. Of these, the large majority have undergone prior nuclear medicine +/- ultrasound *i.e.*, the CT/MRI is usually a third-line test. However, of 291 cases undergoing CT/MRI where data on nuclear medicine / ultrasound are present:

- 4 patients had neither nuclear medicine nor ultrasound performed.
- 95 patients (33%) had both positive nuclear medicine and positive ultrasound results, raising the question as to the added utility of the cross-sectional imaging (although nuclear medicine and ultrasound may have been both positive, but non-concordant in exact location).

PET scanning is used very infrequently, and appears to have a very low sensitivity when used.

The use of invasive techniques such as selective venous sampling seems anomalous prior to first-time surgery.

Methylene blue usage varies considerably between surgeons: of 107 members for whom data on methylene blue localisation data are available, this technique was used:

- Routinely (>90% of operations) by 14 members.
- Selectively (0.5-90.0% of operations) by 24 members.
- Never by 68 members.

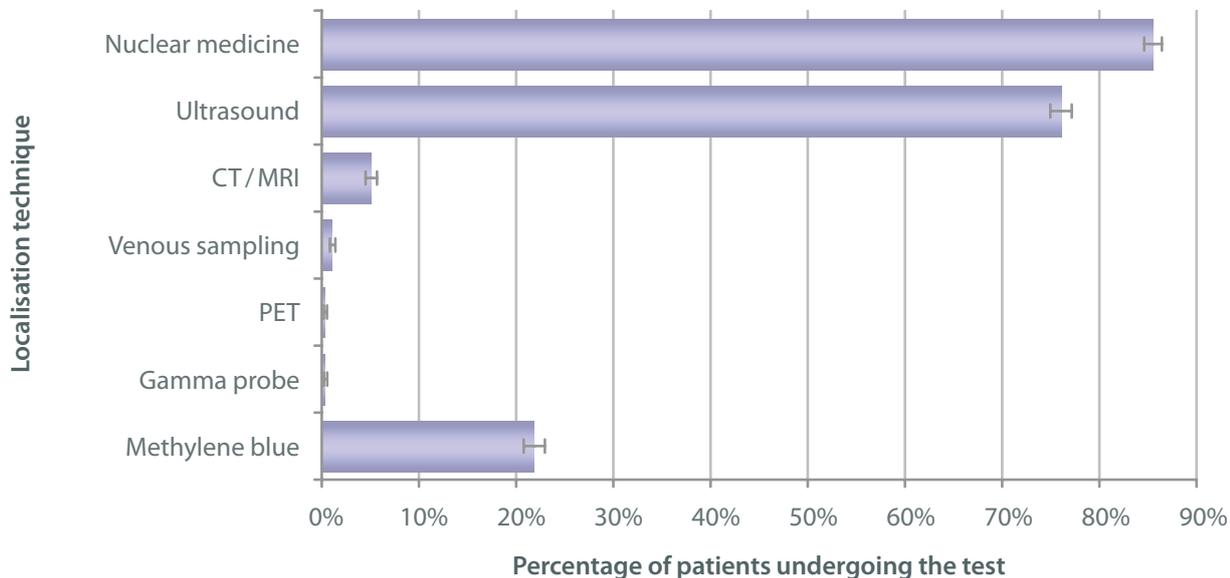
Localisation is performed much less frequently for renal HPT (nuclear medicine 13.5%, USS 11%, CT/MRI 1.5%), presumably because the surgeon would be planning a bilateral exploration anyway.

First-time parathyroid surgery for primary HPT: localisation techniques used

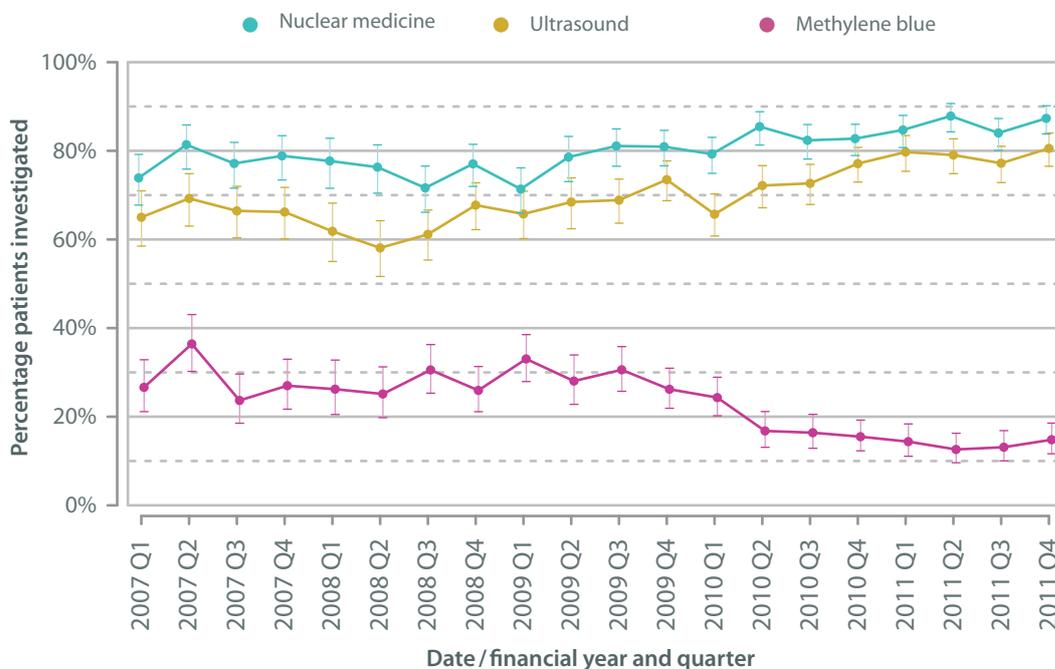
		Localisation technique result				
		Not done	Negative	Positive	Unspecified	Test rate (95% CI)
Localisation technique	Nuclear medicine	847	1,515	3,498	32	85.5% (84.6-86.4%)
	Ultrasound	1,399	1,816	2,632	45	76.1% (75.0-77.2%)
	CT/MRI	5,251	136	144	361	5.1% (4.5-5.7%)
	Venous sampling	5,562	18	43	269	1.1% (0.8-1.4%)
	PET	5,597	16	3	276	0.3% (0.2-0.5%)
	Gamma probe	5,598	16	4	274	0.4% (0.2-0.6%)
	Methylene blue	4,407	195	1,037	253	21.8% (20.8-23.0%)



**First-time parathyroid surgery for primary HPT:
Localisation techniques used**



**Parathyroid surgery for primary HPT:
Changes in the use of localisation over time**





Targeted approach

Localisation techniques and the targeted approach

The concept of targeted surgery is to utilise imaging to identify those cases with single accessible adenomas, and thereby allow a more focussed dissection, potentially to improve cosmesis and reduce morbidity.

Targeted surgery may be achieved by a number of methods (mini-incision open approach, endoscopic *etc.*), and the audit does not specify which are utilised.

However, it is interesting to note that of those patients who have both nuclear medicine & ultrasound, presumably with the intention of performing targeted surgery, only 51.6% (n=5,222) ultimately undergo a targeted operation.

The reasons for this are explored further below.

Parathyroid surgery: targeted approach and the number of localisation techniques used

		Number of localisation techniques used			
		None	One or more	Unspecified	All
Targeted approach	No	1,005	3,608	4	4,617
	Yes	2	3,280	3	3,285
	Unspecified	17	217	483	717
	All	1,024	7,105	490	8,619

First-time parathyroid surgery: localisation techniques used

			Localisation technique result				
			Not done	Negative	Positive	Unspecified	Test rate
Localisation technique	Not targeted	Nuclear medicine	1,617	1,585	1,372	43	64.6%
		Ultrasound	1,834	1,791	933	59	59.8%
		CT/MRI	4,048	161	132	276	6.7%
		Venous sampling	4,309	26	57	225	1.9%
		PET	4,359	27	5	226	0.7%
		Gamma probe	4,359	18	6	234	0.5%
		Methylene blue	3,261	185	933	238	25.5%
	Targeted	Nuclear medicine	54	232	2,992	7	98.4%
		Ultrasound	517	444	2,304	20	84.2%
		CT/MRI	2,911	66	130	178	6.3%
		Venous sampling	3,099	9	52	125	1.9%
		PET	3,139	7	4	135	0.3%
		Gamma probe	3,142	8	0	135	0.3%
		Methylene blue	2,628	66	488	103	17.4%



First-time parathyroid surgery for primary HPT: localisation techniques used

		Localisation technique result					
		Not done	Negative	Positive	Unspecified	Test rate	
Localisation technique	Not targeted	Nuclear medicine	797	1,302	997	20	74.3%
		Ultrasound	958	1,440	692	26	69.0%
		CT/MRI	2,763	94	59	200	5.2%
		Venous sampling	2,943	10	15	148	0.8%
		PET	2,954	11	1	150	0.4%
		Gamma probe	2,957	11	4	144	0.5%
		Methylene blue	2,141	143	690	142	28.0%
	Targeted	Nuclear medicine	41	195	2,436	3	98.5%
		Ultrasound	428	352	1,889	6	84.0%
		CT/MRI	2,425	42	78	130	4.7%
		Venous sampling	2,557	5	23	90	1.1%
		PET	2,573	4	2	96	0.2%
		Gamma probe	2,576	3	0	96	0.1%
		Methylene blue	2,219	49	330	77	14.6%



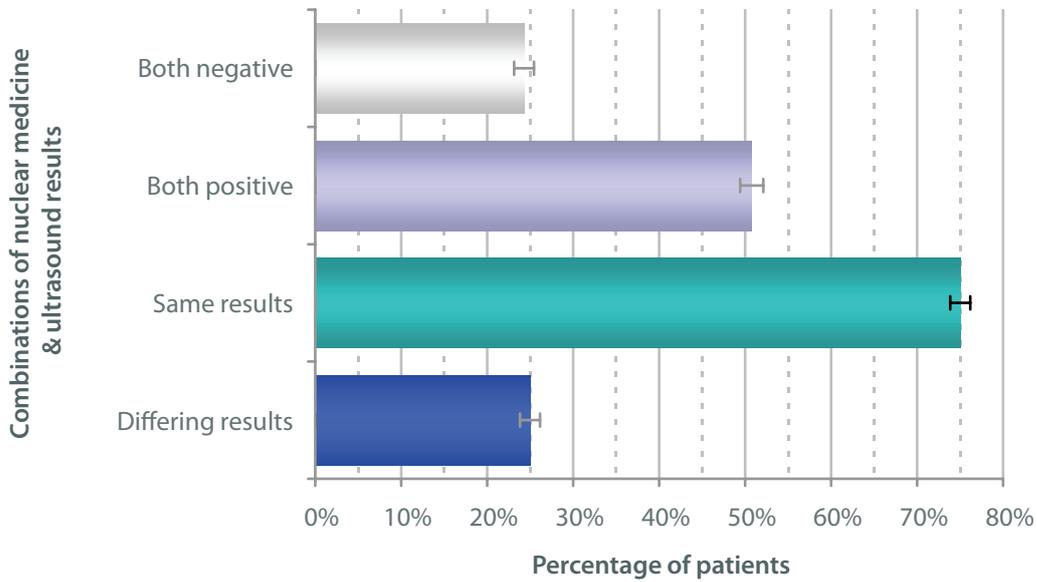
The utility of parathyroid localisation in first-time surgery for primary HPT is in facilitating targeted surgery. True concordance between imaging results is therefore best assessed by examining their usage in relation to the subsequent use and success of targeted surgery.

For the commonest combination of nuclear medicine & ultrasound:

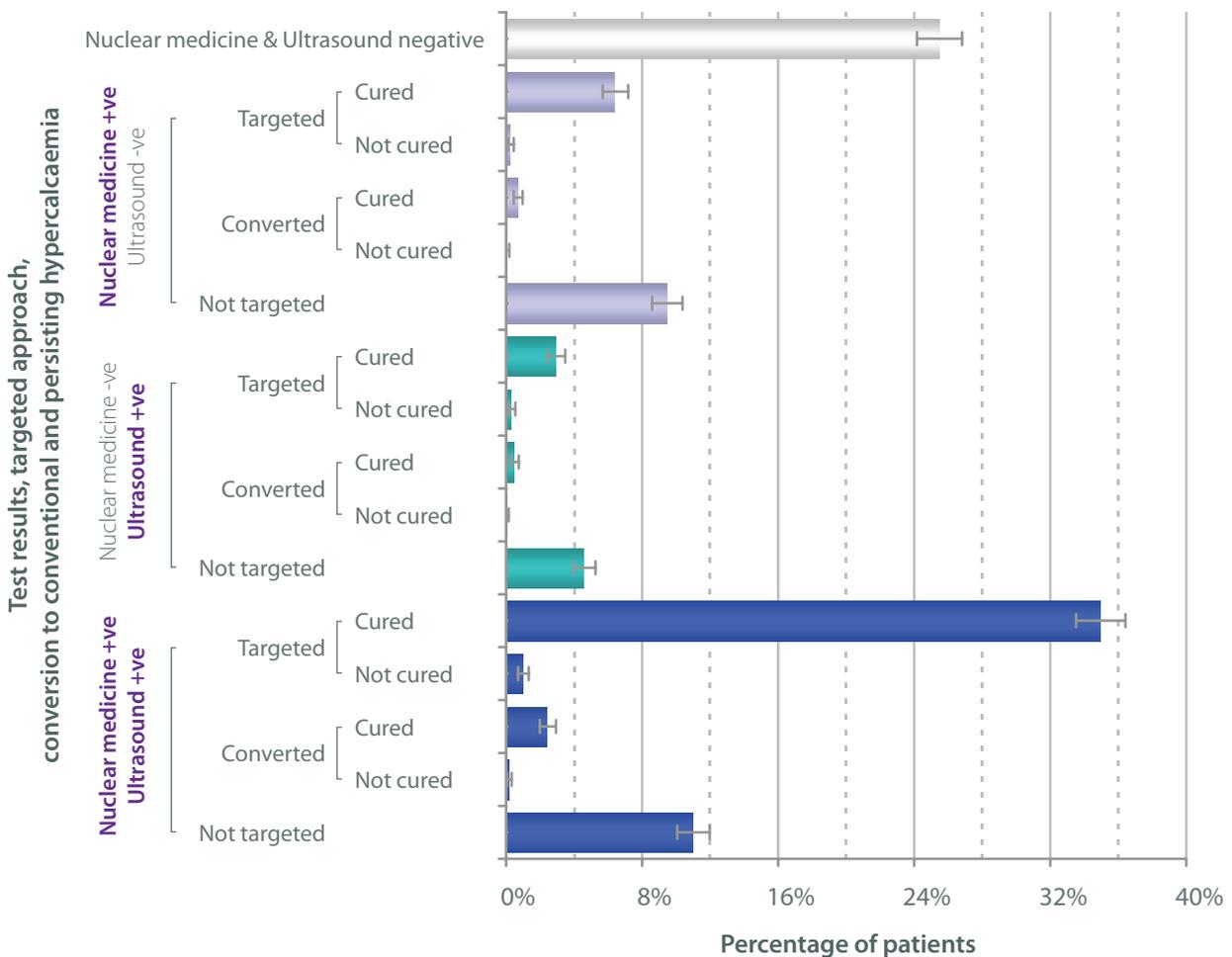
- Approximately 40% of cases have either one or both scans negative and go on to bilateral neck exploration (BNE).
- Around a further 10% have both scans positive, but go on to BNE (presumably due to discrepancy in exact localisation, or detection of multi-gland disease).
- Around 50% are deemed suitable for targeted surgery, of whom a small percentage are converted to BNE.



Parathyroid surgery: Agreement between nuclear medicine and ultrasound tests (n=5,352)



Parathyroid surgery: Concordance between nuclear medicine and ultrasound tests (n=5,352)





qPTH and conversion

Conversion from targeted surgery to conventional surgery (usually BNE) is commoner (2-fold) if qPTH is used ($\chi^2 = 33.8, p < 0.001$). After conversion, the proportion with multi-gland disease is slightly higher in the qPTH group, particularly for hyperplasia (presumed cause for 3.5 gland excisions).

Parathyroid surgery using the targeted approach: qPTH and conversion

		Converted to conventional				Conversion rate
		No	Yes	Unspecified	All	
qPTH used	No	2,098	148	129	2,366	6.6%
	Yes	689	105	55	849	13.2%
	Unspecified	41	7	22	70	14.6%
	All	2,819	260	206	3,285	8.4%

Parathyroid surgery using the targeted approach and were converted to a conventional approach: number of glands removed

		qPTH used			
		No	Yes	Unspecified	All
Glands removed	0 glands	1	2	1	4
	1 gland	100	61	4	165
	2 glands	29	22	1	52
	3 glands	9	4	0	13
	3.5 glands	0	10	0	10
	4 glands	0	0	0	0
	Unspecified	9	6	1	16
	All	148	105	7	260



Glands removed and the targeted approach

The data suggest that the major causes of conversion to conventional approach are:

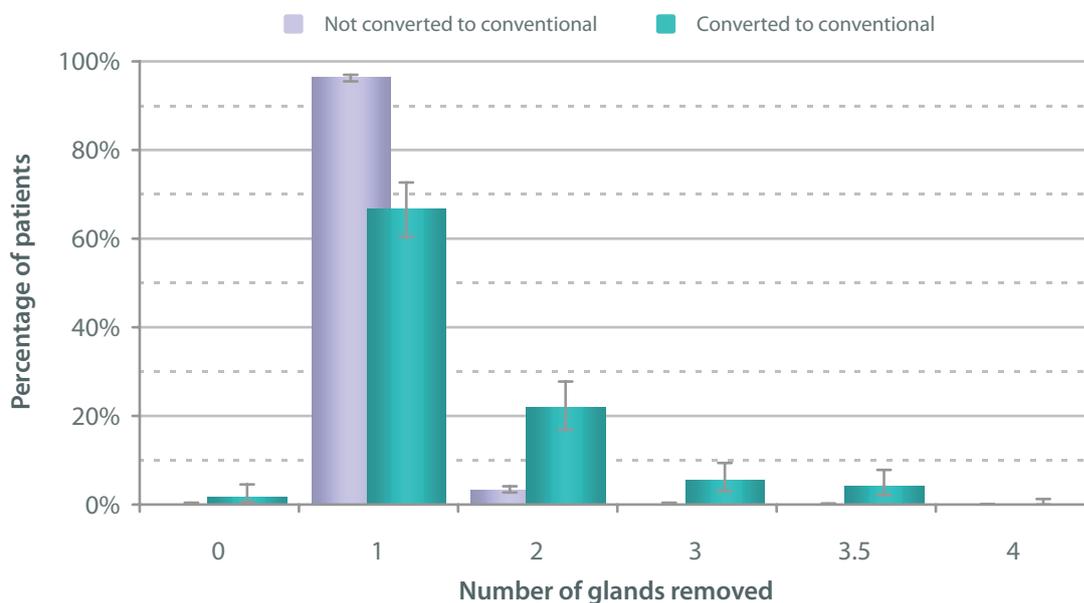
- Multi-gland disease, perhaps suspected at targeted surgery due to:
- Appearances suggestive of hyperplasia.
- Observation of a second abnormal gland adjacent to the targeted gland.
- Use of qPTH (all 10 of the 3.5 gland excisions).
- Failure to locate the abnormal parathyroid at targeted surgery (for those cases where only one gland was excised after conversion), or requirement for greater access due to lesion size, difficulties in dissection *etc.*

It is interesting that 89 patients had two abnormal glands found at targeted surgery, and yet were not converted to BNE. Likewise, it is hard to reconcile excision of 3 or 3.5 glands with a true targeted operation, as this implies conversion to BNE must have occurred.

Parathyroid surgery using the targeted approach for patients with a primary pathology: number of glands removed and conversion to the conventional approach

		Converted to conventional			
		No	Yes	Unspecified	All
Glands removed	0 glands	4	4	0	8
	1 gland	2,557	159	171	2,887
	2 glands	89	52	7	148
	3 glands	4	13	1	18
	3.5 glands	1	10	2	13
	4 glands	0	0	0	0
	Unspecified	31	14	9	54
	All	2,686	252	190	3,128

Parathyroid surgery using the targeted approach for primary pathology:
Number of glands removed and conversion (n=2,893)





Operation

Operation sequence

The proportion with *unspecified* data for this field has improved since the 2009 report. This may also explain an apparent reduction in the proportion of re-operative cases to 5.9% of all cases (6.6% in 2009).

Parathyroid surgery: number of previous operations

		Operation sequence			
		First-time	Redo	Unspecified	All
Previous operations	None	6,794	0	0	6,794
	One	0	347	0	347
	Two	0	45	0	45
	Three	0	7	0	7
	Four	0	5	0	5
	Unspecified	0	21	1,400	1,421
	All	6,797	425	1,400	8,619



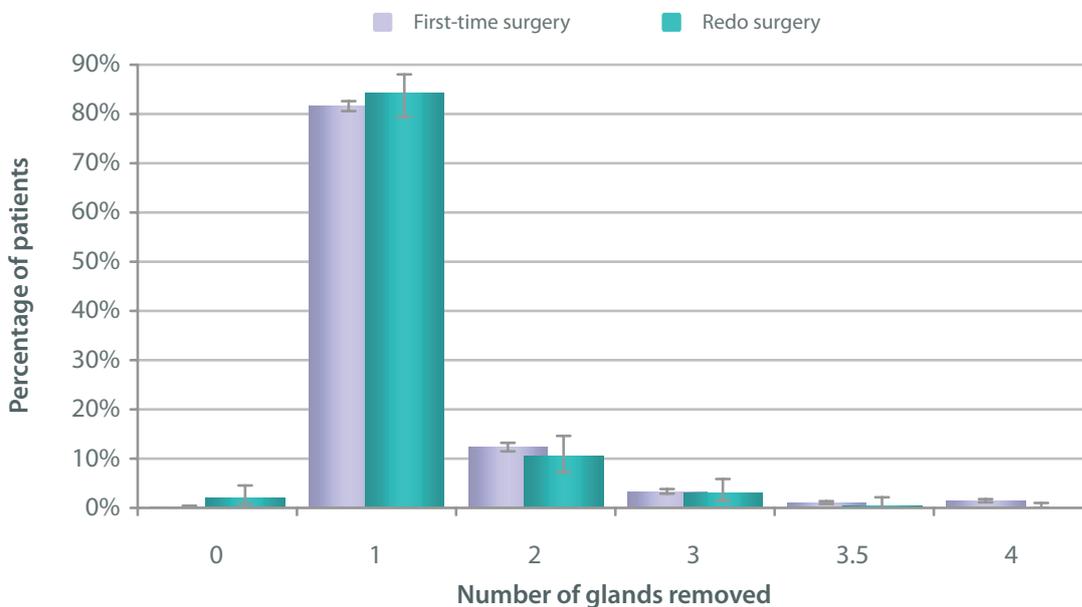
Glands removed and operation sequence

The distribution of number of glands removed is similar for re-do and first-time surgery, with most having only one gland excised, and in over 88% of cases this gland was found in the neck, presumably representing a failed prior exploration.

Parathyroid surgery for patients with a non-MEN primary pathology: number of glands removed and operation sequence

		Operation sequence			
		First-time	Redo	Unspecified	All
Glands removed	0 glands	21	0	0	21
	1 gland	5,458	39	0	6,497
	2 glands	826	28	0	854
	3 glands	238	19	0	257
	3.5 glands	74	20	0	94
	4 glands	108	20	0	128
	Unspecified	219	3	0	222
	All	6,944	129	0	7,073

**Parathyroid surgery for patients with a non-MEN primary pathology:
Number of glands removed and operation sequence (n=5,987)**





Glands removed for patients with primary pathology

Glands removed and MEN

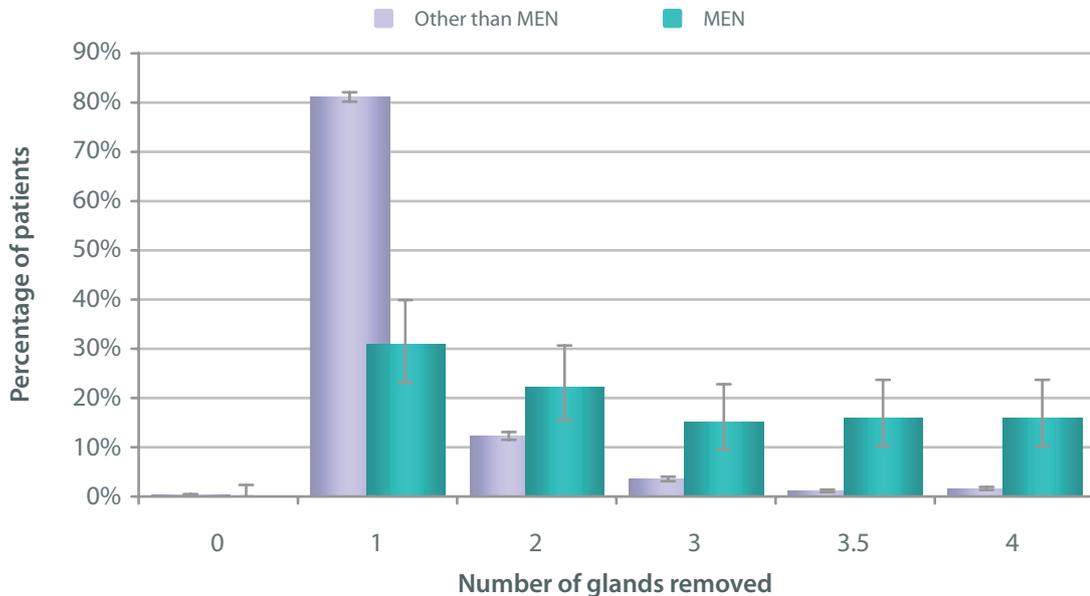
Not surprisingly, the incidence of multi-gland disease is high in MEN, but it is interesting that single gland excision was performed in around 30% of MEN cases. This may contribute to the higher rate of persistent HPT in MEN compared to sporadic HPT (see below).

Surgery for parathyroid disease

Parathyroid surgery for patients with a primary pathology: number of glands removed and MEN pathology

		MEN			
		No	Yes	Unspecified	All
Glands removed	0 glands	21	0	0	21
	1 gland	5,458	39	0	6,497
	2 glands	826	28	0	854
	3 glands	238	19	0	257
	3.5 glands	74	20	0	94
	4 glands	108	20	0	128
	Unspecified	219	3	0	222
	All	6,944	129	0	7,073

Parathyroid surgery for primary pathology: Number of glands removed and the incidence of MEN (n=6,851)





Glands removed and age at operation

Again, the incidence of *double adenomas* does not seem to have a marked predominance in the over 60 age group, contradicting traditional teaching!

First-time surgery for primary HPT: age and number of glands removed

		Number of glands removed				All
		<=1 gland	2 glands	>2 glands	Unspecified	
Age at surgery / years	<21	31	3	2	1	37
	21-30	111	16	16	2	145
	31-40	244	33	29	7	313
	41-50	594	66	48	11	719
	51-60	1,115	155	81	24	1,375
	61-70	1,286	241	73	35	1,635
	71-80	1,036	154	66	22	1,278
	>80	242	33	15	6	296
	Unspecified	0	0	0	0	0
	All	4,659	701	330	108	5,798

First-time surgery for non-MEN HPT:
Age and number of glands removed (n=5,690)





Surgeon

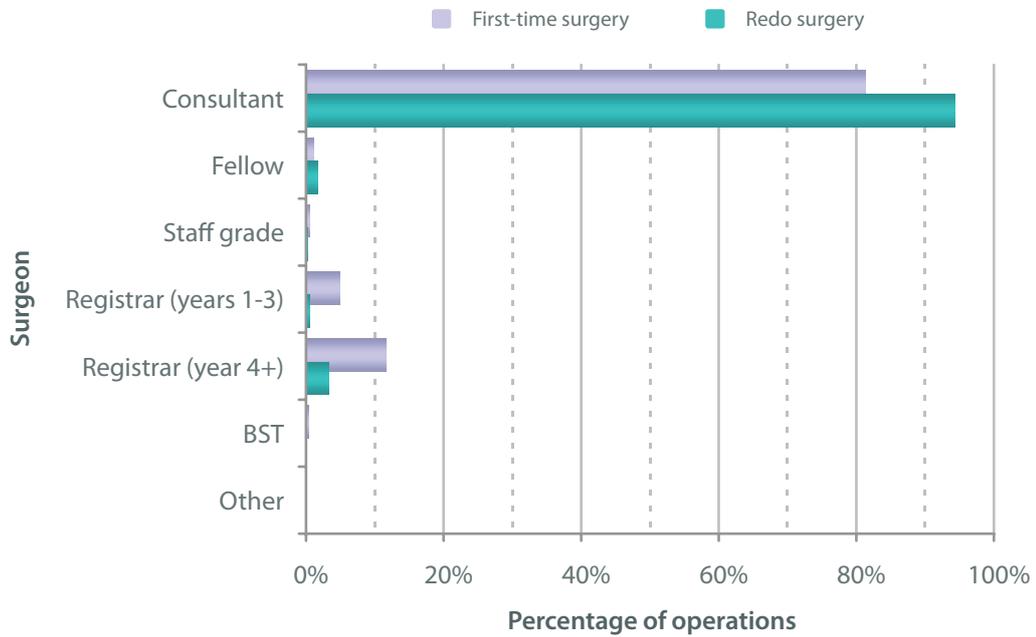
As with thyroid surgery, parathyroidectomy is largely consultant-delivered.

A middle-grade doctor was recorded as primary surgeon in 1,462 (17.8%) cases over the life-time of the database.

Parathyroid surgery: surgeon and operation sequence

		Operation sequence			
		First-time	Redo	Unspecified	All
Surgeon	Consultant	5,512	400	798	6,710
	Fellow	72	7	40	119
	Staff grade	38	1	2	41
	Registrar (years 1-3)	334	2	62	398
	Registrar (years 4+)	791	14	99	904
	BST	26	0	6	32
	Other	5	0	0	5
	Unspecified	16	1	393	410
	All	6,794	425	1,400	8,619

Parathyroid surgery: Surgeon (n=7,202)



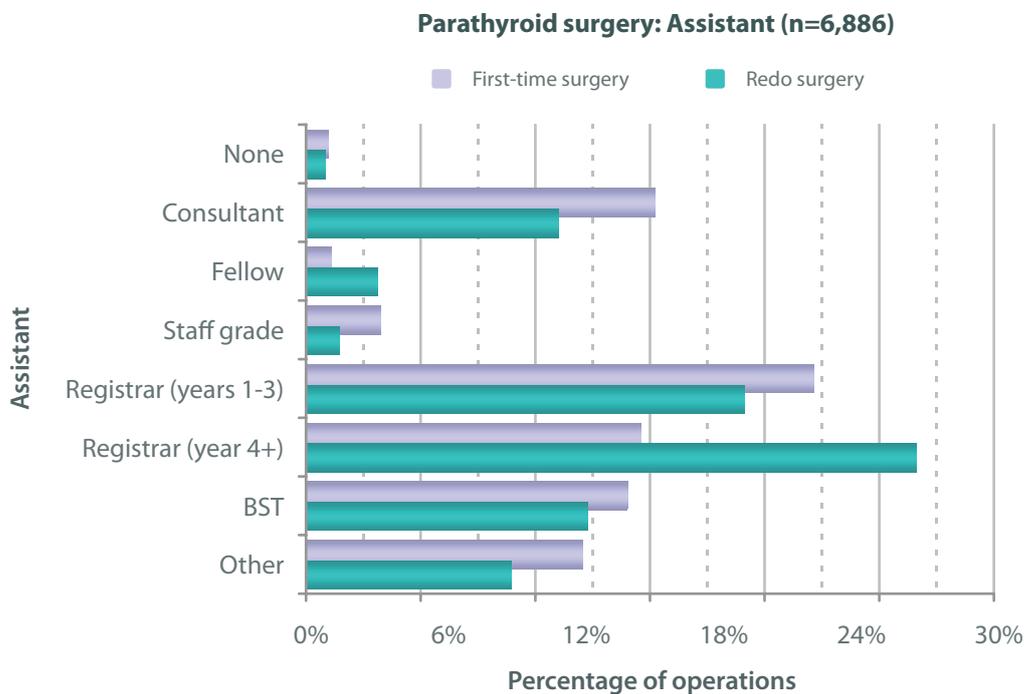


Assistant

Parathyroid surgery: assistant and operation sequence

		Operation sequence			
		First-time	Redo	Unspecified	All
Assistant	None	76	4	3	83
	Consultant	1,184	53	213	1,450
	Fellow	86	15	44	145
	Staff grade	253	7	35	295
	Registrar (years 1-3)	1,722	92	217	2,031
	Registrar (years 4+)	1,135	128	163	1,426
	BST	1,091	59	130	1,280
	Other	938	43	138	1,119
	Unspecified	309	24	457	790
	All	6,794	425	1,400	8,619

Surgery for parathyroid disease





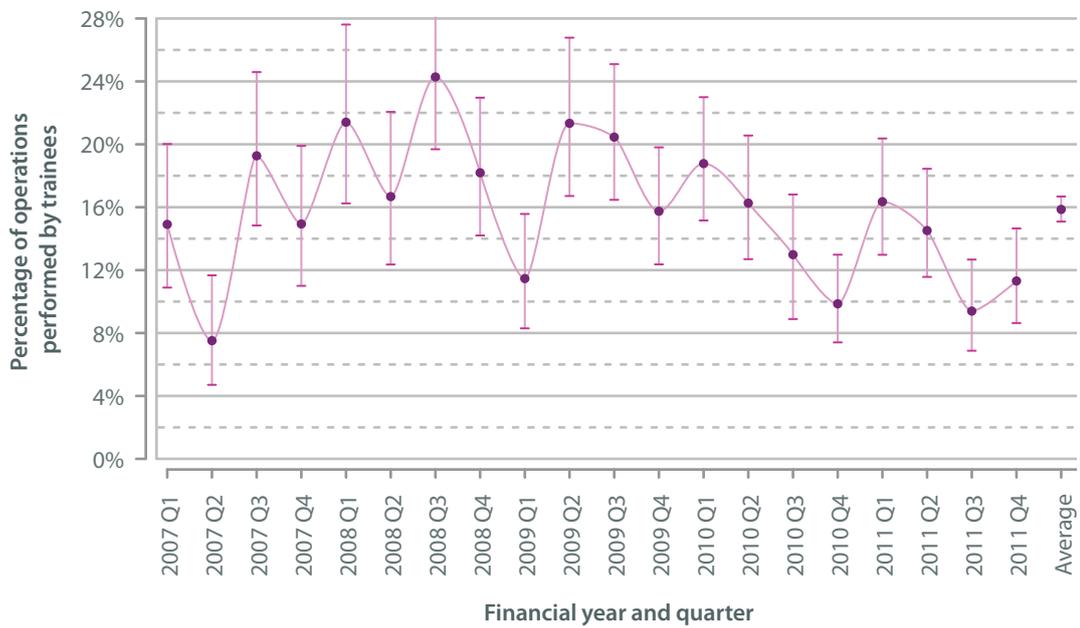
Consultant involvement

Consultant involvement:

- All surgery 96.8% (8,203; 96.4-97.1%).
- First-time operations 97.0% (6,775; 96.5-97.3%).
- Redo surgery 98.6% (423; 96.8-99.4%).

Surgery for parathyroid disease

Parathyroid surgery:
Proportion of procedures performed by trainees (n=8,209)







Outcomes

Persisting hypercalcaemia

Persistent hypercalcaemia is a key outcome measure after surgery for primary HPT.

Univariate analysis shows several potential risk factors for persistence of hypercalcaemia after parathyroidectomy: re-operative surgery and operations for MEN-associated HPT clearly have a high relative risk, although these cases form only a minority of the total. For first-time, primary HPT there are trends towards improved cure rates with use of qPTH and targeted surgery.

However, much of this apparent improvement may be dependent upon imaging outcome. So, while performance of localisation studies (nuclear medicine ± ultrasound) does not *per se* improve results, there is a significantly lower rate of persistent HPT for cases where nuclear medicine is positive.

Clearly there will be interaction between these variables. For example:

- Most targeted surgery is only performed if nuclear medicine is positive.
- qPTH may be more commonly used in targeted surgery.
- Non-targeted surgery will be used if localisation is either not performed or is negative.
- Imaging is usually employed before re-do surgery.

Parathyroid surgery for patients with a primary pathology: persisting hypercalcaemia

			Persisting hypercalcaemia			
			No	Yes	Unspecified	Rate (95% CI)
Groupings	Pathology	All primary pathology	5,647	308	1,118	5.2% (4.6-5.8%)
		Not MEN	5,561	297	1,086	5.1% (4.5-5.7%)
		MEN	86	11	32	11.3% (6.1-19.8%)
	Operation sequence	First-time surgery	4,796	237	859	4.7% (4.1-5.3%)
		Redo surgery	236	43	75	15.4% (11.5-20.3%)
		Unspecified	615	28	184	4.4% (3.0-6.3%)
	qPTH used	No	4,426	255	828	5.4% (4.8-6.1%)
		Yes	1,074	45	192	4.0% (3.0-5.4%)
		Unspecified	147	8	98	5.2% (2.4-10.3%)
	Localised	No	383	22	91	5.4% (3.5-8.2%)
		Yes	5,260	286	1,019	5.2% (4.6-5.8%)
		Unspecified	4	0	8	0.0% (0.0-52.7%)
	Nuclear medicine	Not done	842	46	123	5.2% (3.9-6.9%)
		Negative	1,411	121	252	7.9% (6.6-9.4%)
		Positive	3,364	138	722	3.9% (3.3-4.7%)
		Unspecified	30	3	21	9.1% (2.4-25.5%)
	Methylene blue	Not done	4,199	237	840	5.3% (4.7-6.1%)
		Done	1,203	57	196	4.5% (3.5-5.9%)
		Unspecified	245	14	82	5.4% (3.1-9.1%)

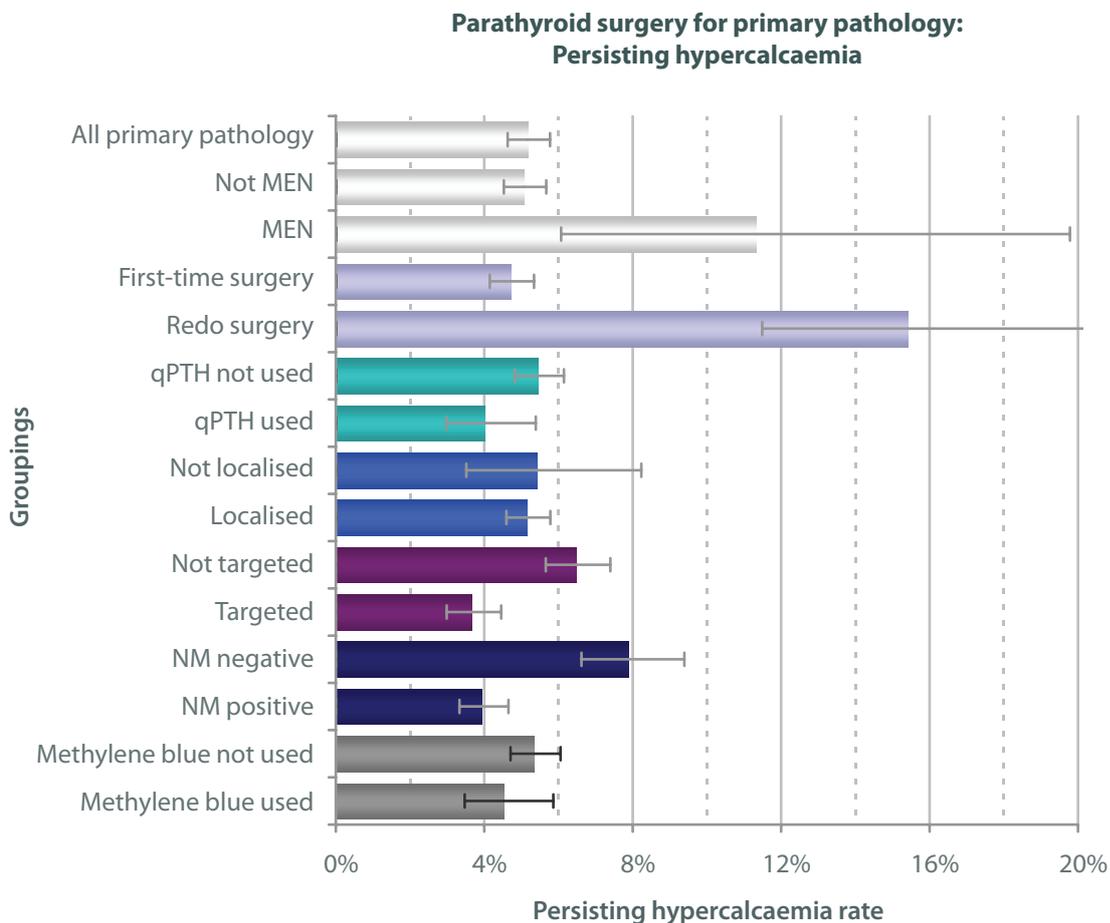


For first-time primary HPT, it is therefore interesting that in multi-variate analysis using multiple logistic regression with persistent hypercalcaemia as the binary outcome, only nuclear medicine positivity remains significant, whatever combinations of other predictor variables are combined (typical odds ratio 0.499, 95% CI: 0.345-0.722; $p=0.0002$).

This would imply that nuclear medicine positivity is in itself a predictor of successful outcome (or MIBI negativity a predictor of failure), irrespective of the surgical approach subsequently undertaken. For instance, persistence after first-time surgery for primary HPT is:

- nuclear medicine positive and targeted surgery: $62 / 2,049 = 3.03\%$ (2.29-3.77%).
- nuclear medicine positive and non-targeted surgery: $36 / 827 = 4.35\%$ (2.96-5.75%).
- nuclear medicine negative: $96 / 1,327 = 7.23\%$ (5.84-8.63%).

The mechanism of this effect is unclear from the audit data, but it may be important to recognise this effect when comparing outcomes between members.

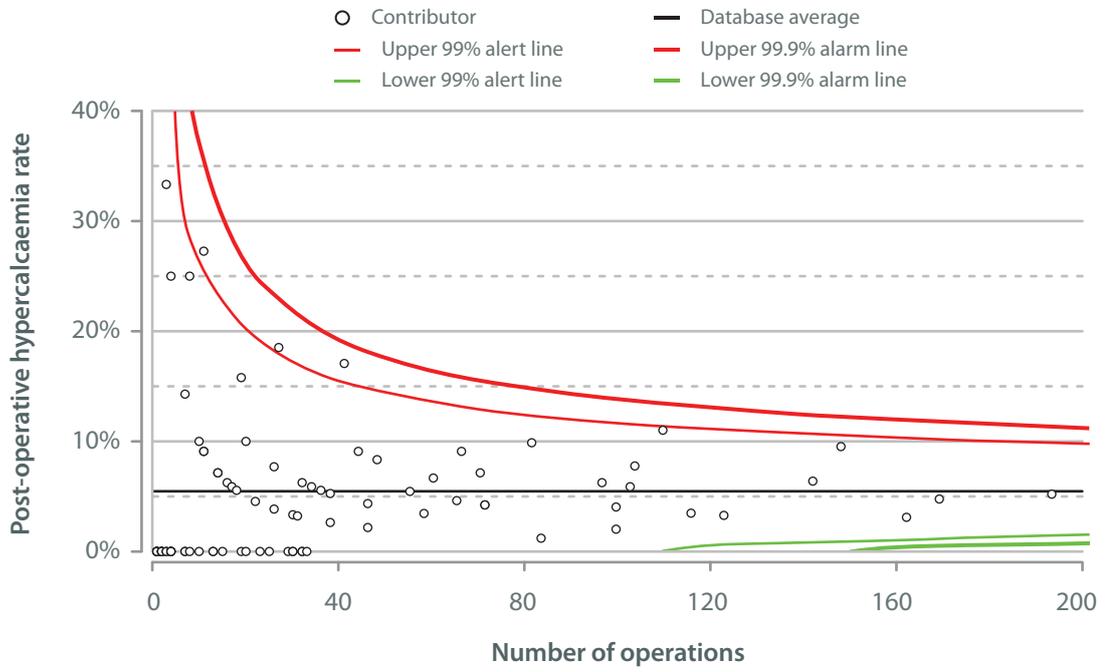




For the main outcome measure of persistent hypercalcaemia after surgery for primary HPT, results are relatively tightly clustered, with only 3 members outside the upper 99% alert line.

Surgery for parathyroid disease

Parathyroid surgery for primary pathology:
Post-operative hypercalcaemia rates; financial years 2009-2011 (n=3,471)

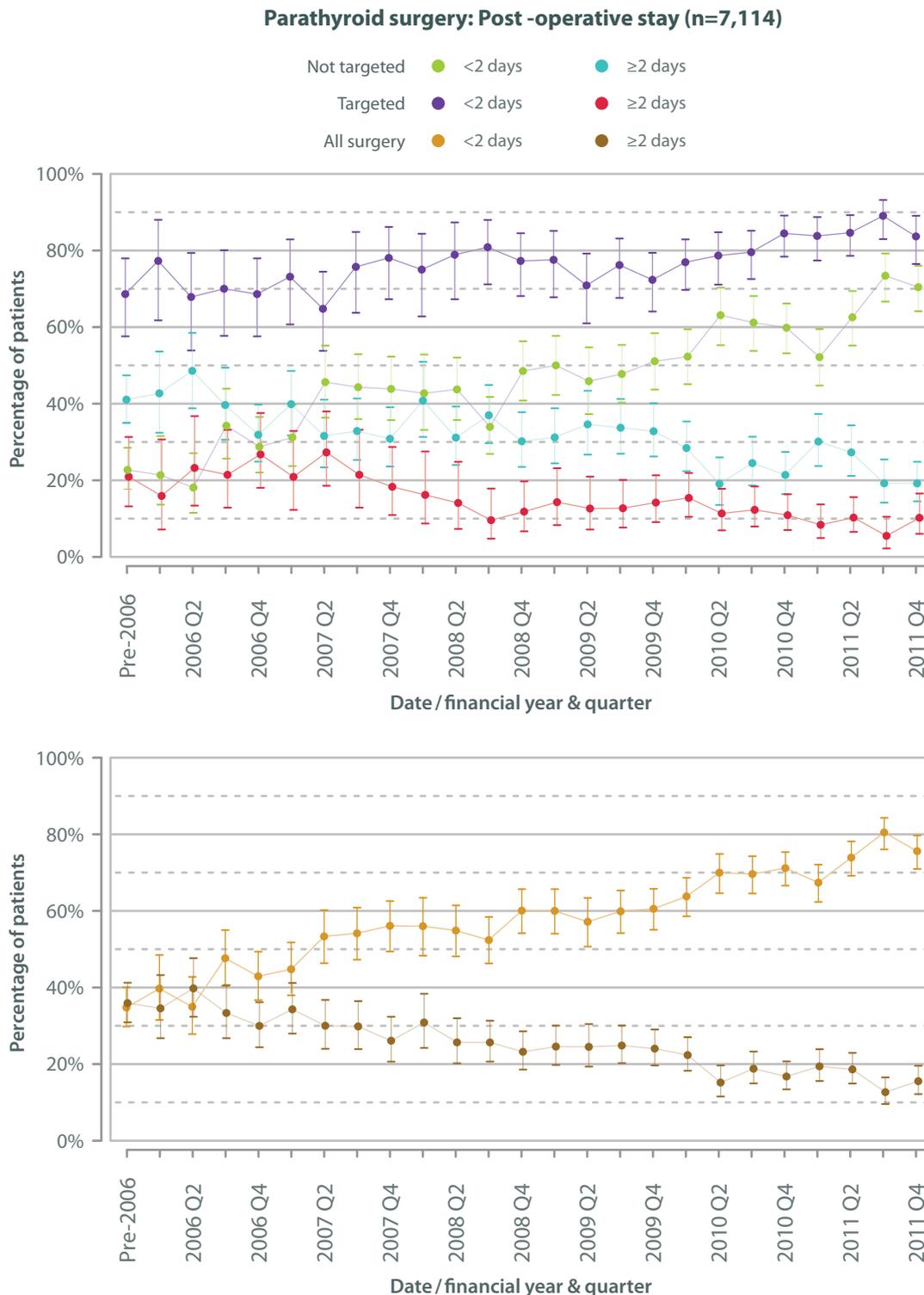




Post-operative stay

As with thyroidectomy, there has been a steady reduction in length-of-stay after parathyroid surgery. This has mainly been due to an increase in proportion of cases staying <2 days, at the expense of stays of 2 or more days. True daycases (stay = 0 days) only represent about 5% of all parathyroid operations. Of these true daycases, most (76.4%) are targeted operations.

The daycase rate for targeted surgery is 11.6%, versus 2.5% for non-targeted surgery.





Proven RLN palsy

As with thyroidectomy, interpretation of the true rate of RLN palsy is hampered by the high rate of missing data and variation in use of (and reporting of) post-operative laryngoscopy. The reported rate of RLN palsy is low after first-time surgery, but, as expected, much higher after re-operative surgery.

The higher rate after surgery for renal disease might be expected, due to the requirement for bilateral exploration: the rate of injury *per* nerve at risk is unlikely to be significantly different than that for primary HPT.

Parathyroid surgery: pathology, operation sequence and new proven RLN palsy

			Proven new RLN palsy			
			No	Yes	Unspecified	Rate (95% CI)
Pathology and operation sequence	Primary	First-time surgery	3,708	31	2,153	0.8% (0.6-1.2%)
		Redo surgery	211	11	132	5.0% (2.6-8.9%)
		Unspecified	542	5	280	0.9% (0.3-2.2%)
	Renal	First-time surgery	337	5	332	1.5% (0.5-3.6%)
		Redo surgery	27	0	31	0.0% (0.0-10.5%)
		Unspecified	46	0	68	0.0% (0.0-6.3%)
	Unspecified	First-time surgery	115	0	113	0.0% (0.0-2.6%)
		Redo surgery	8	0	5	0.0% (0.0-31.2%)
		Unspecified	24	1	434	4.0% (0.2-22.3%)

Re-operation for haemorrhage

The rate of re-exploration for bleeding is reassuringly low after parathyroid surgery.

Targeted surgery is not immune from this complication, although the rate of bleeding is lower than for non-targeted surgery at 0.38% *versus* 0.69%.

Parathyroid surgery: pathology, operation sequence and re-operation for haemorrhage

			Re-operation for haemorrhage			
			No	Yes	Unspecified	Rate (95% CI)
Pathology and operation sequence	Primary	First-time surgery	5,643	29	220	0.5% (0.3-0.7%)
		Redo surgery	338	4	12	1.2% (0.4-3.2%)
		Unspecified	752	3	72	0.4% (0.1-1.3%)
	Renal	First-time surgery	588	6	80	1.0% (0.4-2.3%)
		Redo surgery	55	0	3	0.0% (0.0-5.3%)
		Unspecified	68	3	43	4.2% (1.1-12.7%)
	Unspecified	First-time surgery	214	0	14	0.0% (0.0-1.4%)
		Redo surgery	9	0	4	0.0% (0.0-28.3%)
		Unspecified	36	0	423	0.0% (0.0-8.0%)



Mortality

The mortality rate following parathyroid surgery is very low (0.2%; n= 7,578 ; 95% CI: 0.1-0.4%).

Mortality is higher in the renal HPT group (1.6%; n=702; 95% CI: 0.8-2.9%) than in the primary pathology group (0.1%; n=6,623; 95% CI: 0.0-0.2%), as expected, due to the known associated co-morbidities of renal failure.

Patient age did not appear to influence the probability of mortality:

Median (IQR) age of survivors = 61 years (51-71 years), compared to 63 years (51-74 years) for those who died (p=0.75, Mann-Whitney U test).

Two deaths occurred in patients under 40 years of age: one aged 32 and one aged 22 years (both renal HPT cases).



Association

British



Surgery for adrenal disease



Surgery for adrenal disease

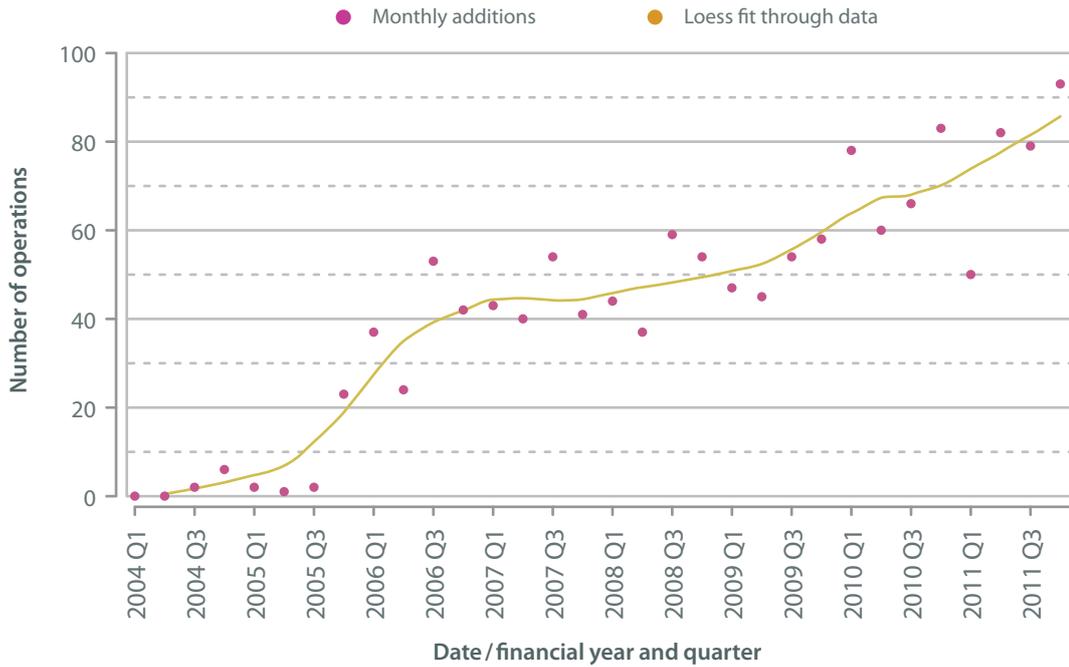
General information from the database

Number of procedures

As with thyroid and parathyroid surgery, there is increasing participation in the audit amongst members reporting adrenal cases.

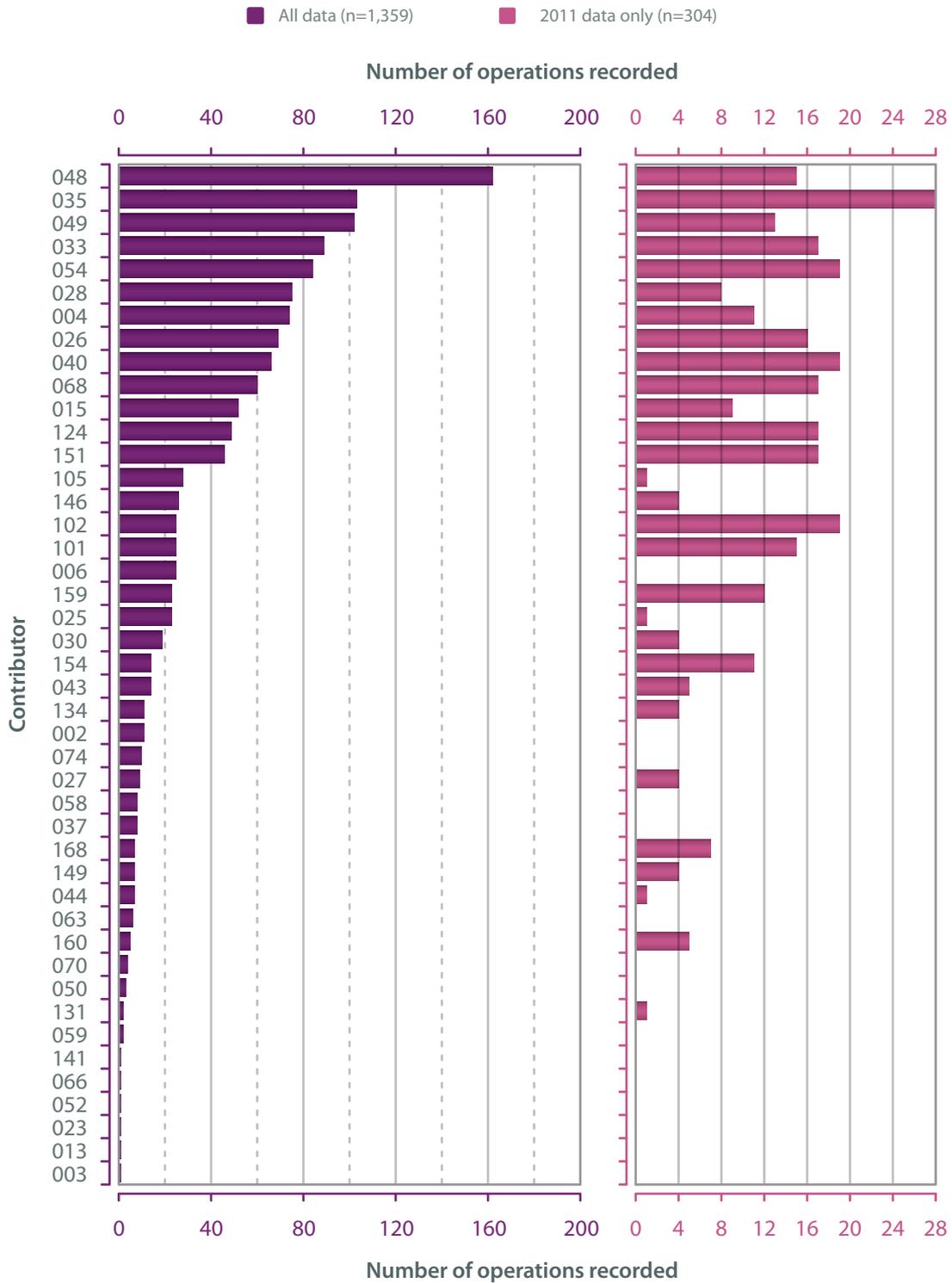
Surgery for adrenal disease

The growth of the database (n=1,359 adrenal cases)





Adrenal surgery: Number of operations reported by each member



Surgery for adrenal disease



Demographics and disease profile

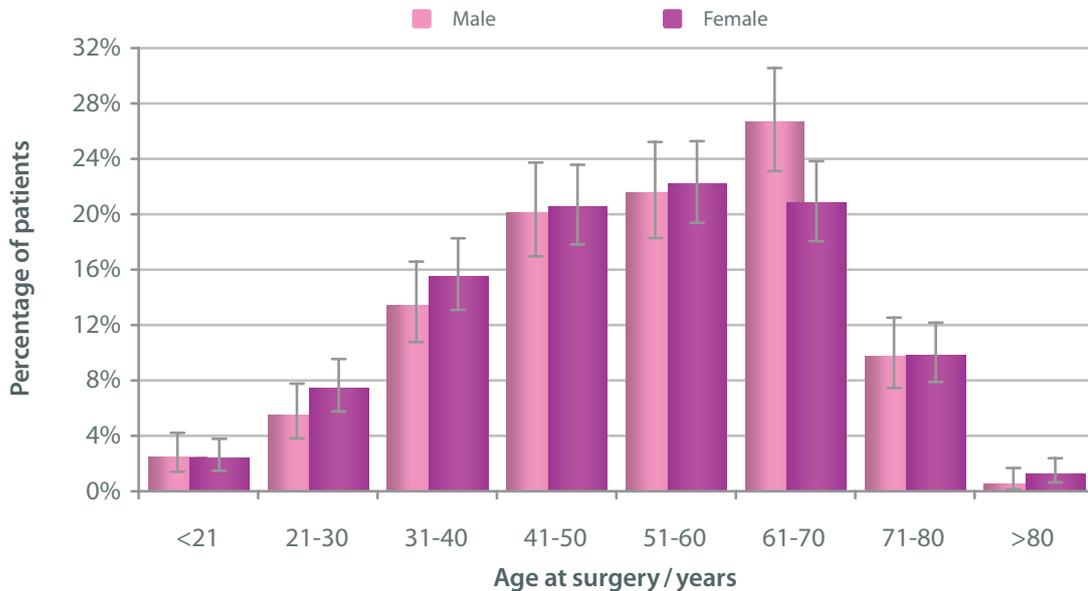
Age and gender

The demographic distribution of adrenal disease has changed little since the last report, with most operations reported in *middle age* and with a slight female predominance.

Adrenal surgery: age and gender distributions

		Gender				Proportion female
		Male	Female	Unspecified	All	
Age at surgery / years	<21	14	19	0	33	57.6%
	21-30	31	59	0	90	65.6%
	31-40	76	123	0	199	61.8%
	41-50	114	163	0	277	58.8%
	51-60	122	176	0	298	59.1%
	61-70	151	165	0	316	52.2%
	71-80	55	78	0	133	58.6%
	>80	3	10	0	13	76.9%
	Unspecified	0	0	0	0	NA
	All	566	793	0	1,359	58.4%

Adrenal surgery: Age distribution (n=1,359)





Diagnosis

The majority of operations are carried out for functional tumours, with pheochromocytoma being the commonest diagnosis.

The 2009 report recorded a slight increase in the rate of metastasectomy from the previous report, and this trend seems to be continuing: 5.0% (95% CI: 3.9-6.3%) compared to 3.0% (95% CI: 1.9-4.5%) in 2009.

The audit design cannot elucidate if this is due to an increasing trend towards active treatment of known metastases, increasing diagnosis of metastatic disease in *incidentalomas* or other reasons.

Other diagnoses include:

- Cysts / pseudo-cysts 16.
- Paragangliomas 13.
- Myelolipoma 8.
- Other mixed / ectopic hormone secreting lesions 7.
- Ganglioneuroma 6.
- Congenital adrenal hyperplasia 4.
- Recurrent Adrenocortical Cancer 4.
- Oncocytoma 2.
- Teratoma 2.
- Sarcoma 2.

Various others including haemangioma, haematoma, a splenunculus, lymphoma.

Adrenal surgery: diagnosis

		Data	
		Count	Rate (95% CI)
Diagnosis	Adenoma	126	9.4% (7.9-11.1%)
	Carcinoma	78	5.8% (4.6-7.2%)
	Conn's	220	16.4% (14.5-18.5%)
	Cushing's	260	19.4% (17.3-21.6%)
	Metastasis	67	5.0% (3.9-6.3%)
	Phaeo	446	33.2% (30.7-35.8%)
	Other	145	10.8% (9.2-12.6%)
	Unspecified	17	
	All	1,359	



Malignancy

Malignancy and diagnosis

Malignancy is recorded as a separate field in the database, allowing some comparison between stated malignancy rates for the various functioning / non-functioning tumours, although such assessment is limited by the relatively high rate of unspecified data (at around 20% overall).

Data for malignancy might be missing due to:

- Doubt as to the true malignant / benign nature of the disease, given the limitations of histology in making this distinction for much adrenal pathology. This might explain why the majority of malignancy **unspecified** cases are in pheochromocytomas, while the majority of definitely malignant cases are carcinomas and metastases.
- *Audit fatigue* (for instance, the *Malignancy* field is unspecified where the *Diagnosis* field implies that malignant status is actually established *i.e.*, benign {adenoma} or malignant {carcinoma}).

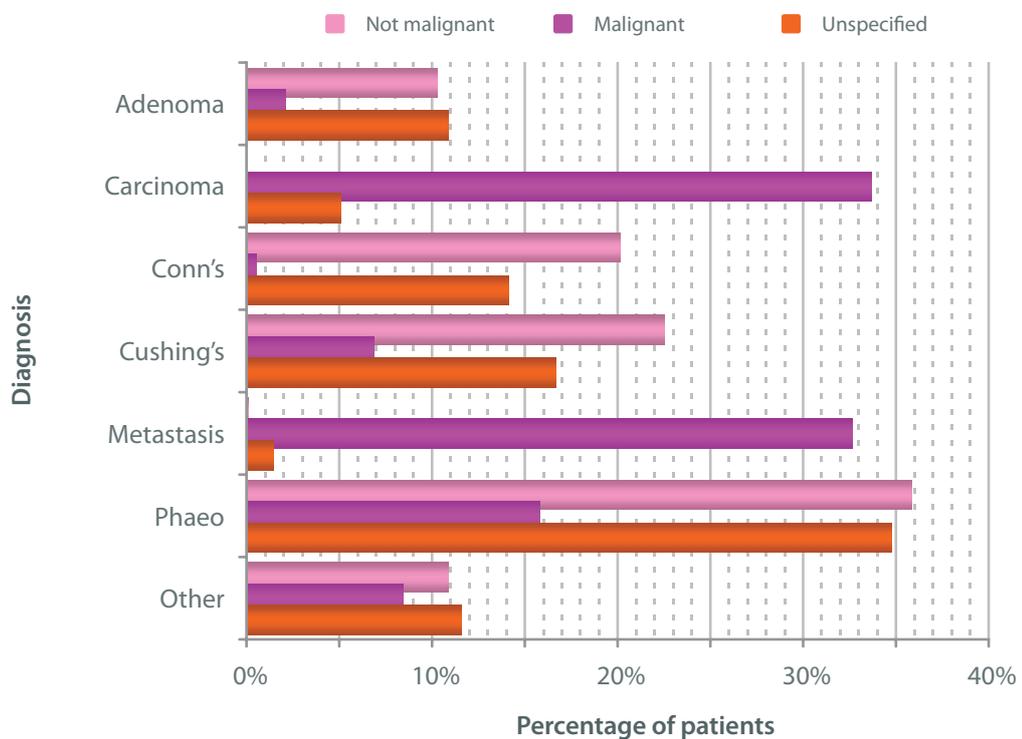
For functioning tumours, the stated rates of malignancy were:

- Conn's: 220 cases, 39 malignancy **unspecified**, 1 malignant = 0.45%.
- Cushing's: 261 cases, 46 malignancy **unspecified**, 13 malignant = 4.98%.
- Pheochromocytoma: 446 cases, 96 malignancy **unspecified**, 30 malignant = 6.73%.

These considerations may influence the differences in stated malignancy rates seen between individual members.

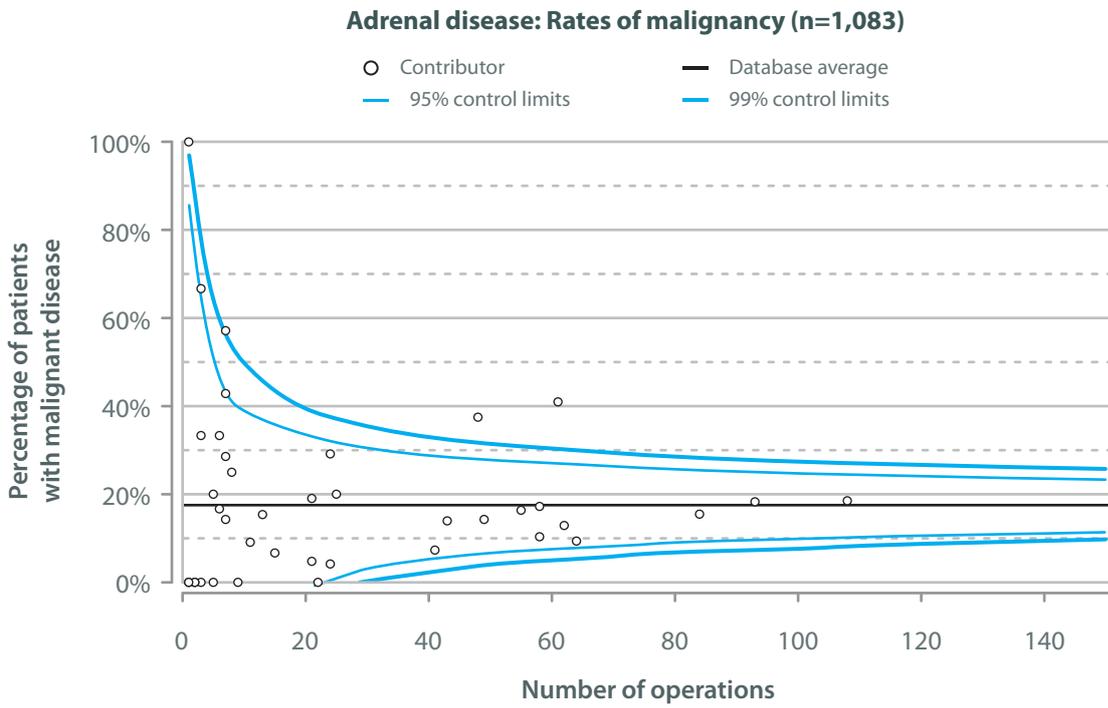
Surgery for adrenal disease

Adrenal surgery: Diagnosis and malignancy (n=1,342)





Malignancy rates for each member





Malignancy and maximum size on radiology

Since the last report the database has been amended to include data on tumour size. This allows some correlation between malignancy risk and lesion size, although, because this is a new field, the number of cases with information on lesion size is limited.

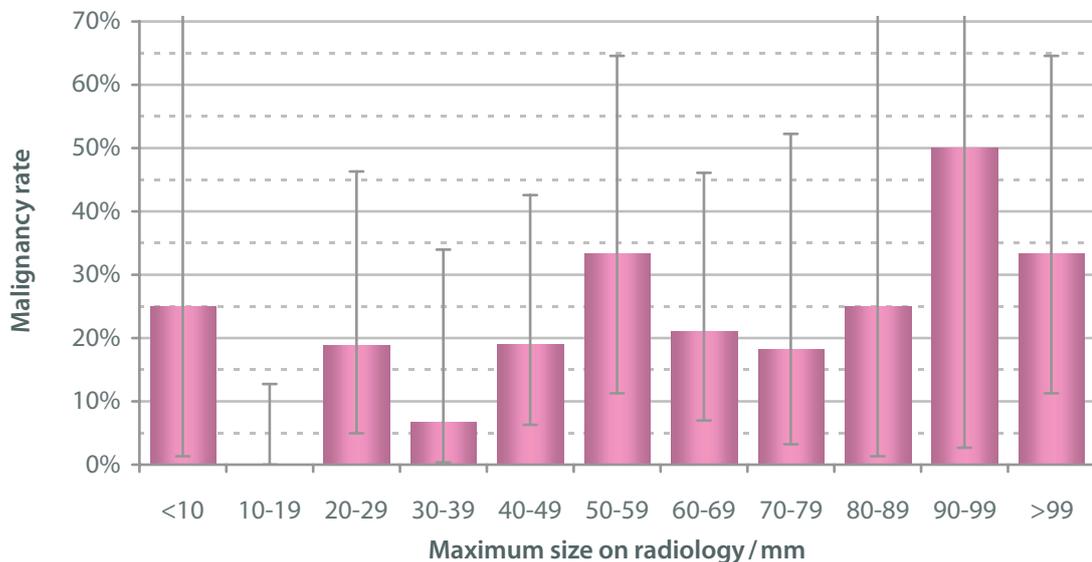
The relationship between malignancy rate and lesion size is not as clear-cut as expected, with a significant proportion under 50 mm. Of the smaller malignant lesions, however, all are represented by either metastases or phaeochromocytomas. The smallest adrenocortical cancer recorded was 50 mm, although, as noted above, the presence or absence of malignancy may be difficult to establish with certainty.

The majority of benign lesions that are >99 mm diameter are phaeochromocytomas (where diagnosis is stated). There are insufficient data on lesion size to examine reliably its influence on surgical approach (laparoscopic *versus* open), but in future this may also be feasible.

Adrenal surgery: malignancy and maximum size by radiology; data collected since the revision of the dataset

		Malignant			Rate (95% CI)
		No	Yes	Unspecified	
Maximum size by radiology / mm	<10	3	1	0	25.0% (1.3-78.1%)
	10-19	22	0	0	0.0% (0.0-12.7%)
	20-29	13	3	3	18.8% (5.0-46.3%)
	30-39	14	1	0	6.7% (0.3-34.0%)
	40-49	17	4	3	19.0% (6.3-42.6%)
	50-59	8	4	0	33.3% (11.3-64.6%)
	60-69	15	4	0	21.1% (7.0-46.1%)
	70-79	9	2	0	18.2% (3.2-52.2%)
	80-89	3	1	0	25.0% (1.3-78.1%)
	90-99	1	1	2	50.0% (2.7-97.3%)
	>99	8	4	1	33.3% (11.3-64.6%)
	Unspecified	19	6	11	
All	132	31	20		

Adrenal surgery: Malignancy and maximum size on radiology (n=138)





Diagnosis and anatomy

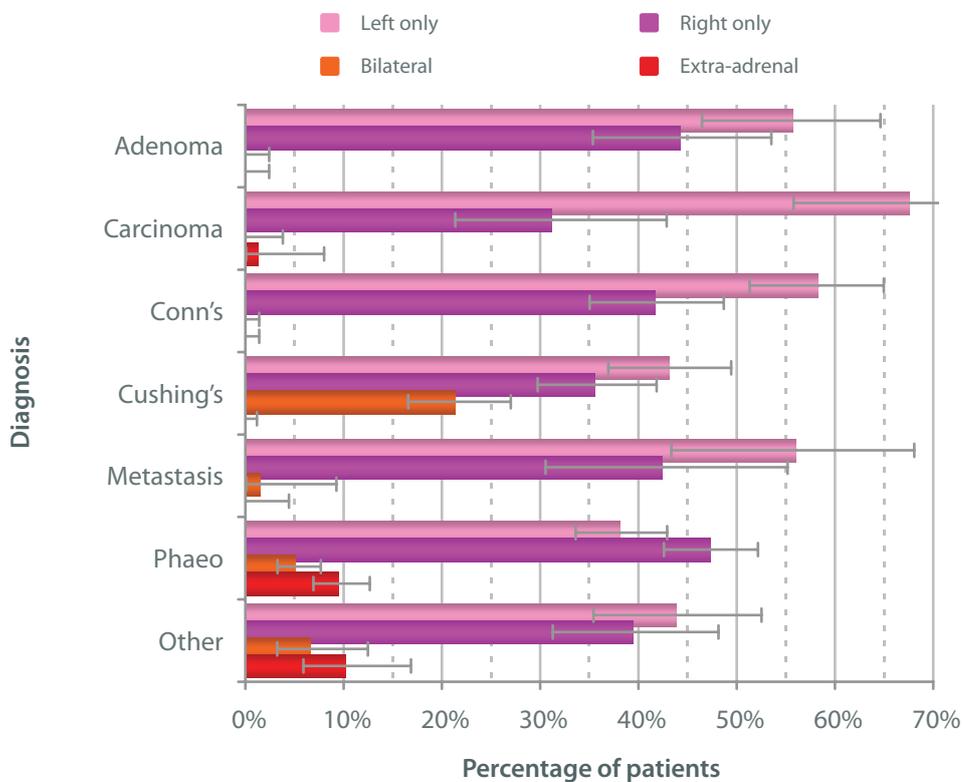
As expected, the majority of bilateral adrenalectomies are performed for pheochromocytoma and Cushing's disease, with the former also accounting for most extra-adrenal pathology.

Adrenal surgery: diagnosis and anatomy

		Anatomy					All
		Left	Right	Bilateral	Extra-adrenal	Unspecified	
Diagnosis	Adenoma	68	54	0	0	4	126
	Carcinoma	52	24	0	1	1	78
	Conn's	123	88	0	0	9	220
	Cushing's	109	90	54	0	7	260
	Metastasis	37	28	1	0	1	67
	Phaeo	166	206	22	41	11	446
	Other	60	54	9	14	8	145
	Unspecified	4	6	0	0	7	17
	All	619	550	86	56	48	1,359

Surgery for adrenal disease

Adrenal surgery: Diagnosis and anatomy (n=1,301)





Operation

Operation type

Overall, the laparoscopic approach to adrenalectomy is favoured, with 81% having an initial laparoscopic approach, of which 8.1% are converted to open surgery.

For laparoscopic surgery, the transperitoneal approach is favoured over the posterior (91.5% transperitoneal), with no significant change since 2009.

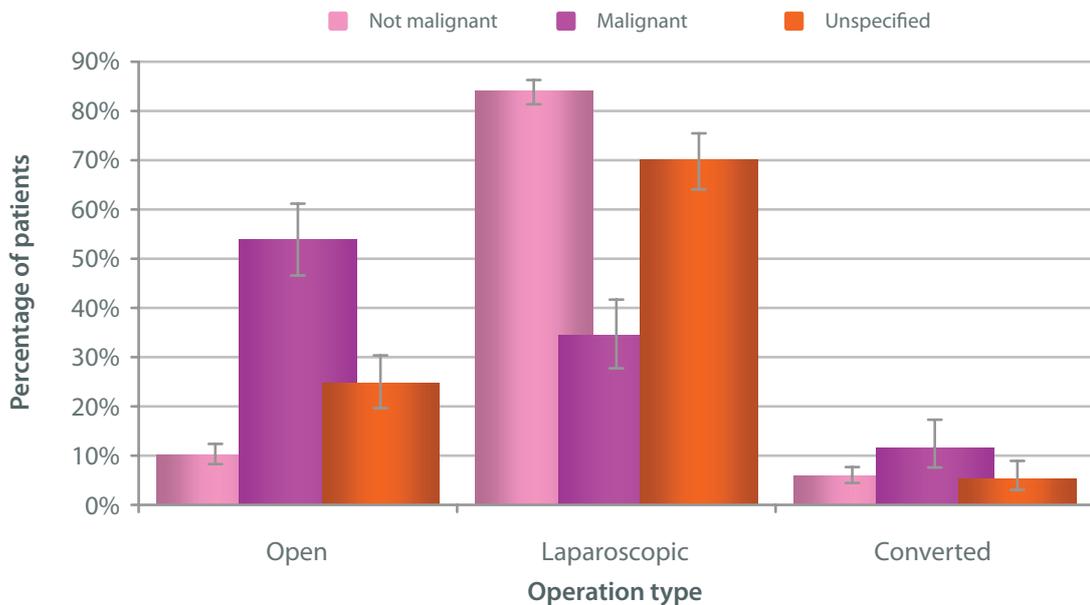
As in the 2009 report, it is clear that for malignant cases:

- Open surgery is more common than laparoscopic.
- Conversion to open surgery is commoner (if the initial approach was laparoscopic) for malignant cases (25.3%; 22 / 87) *versus* benign (6.5%; 52 / 796).

Adrenal surgery: operation type and malignancy

		Malignant			
		No	Yes	Unspecified	All
Operation type	Open	90	102	65	257
	Laparoscopic	744	65	185	994
	Converted	52	22	14	88
	Unspecified	7	1	12	20
	All	893	190	276	1,359

Adrenal surgery: Operation type and malignancy (n=1,339)





The surgical team

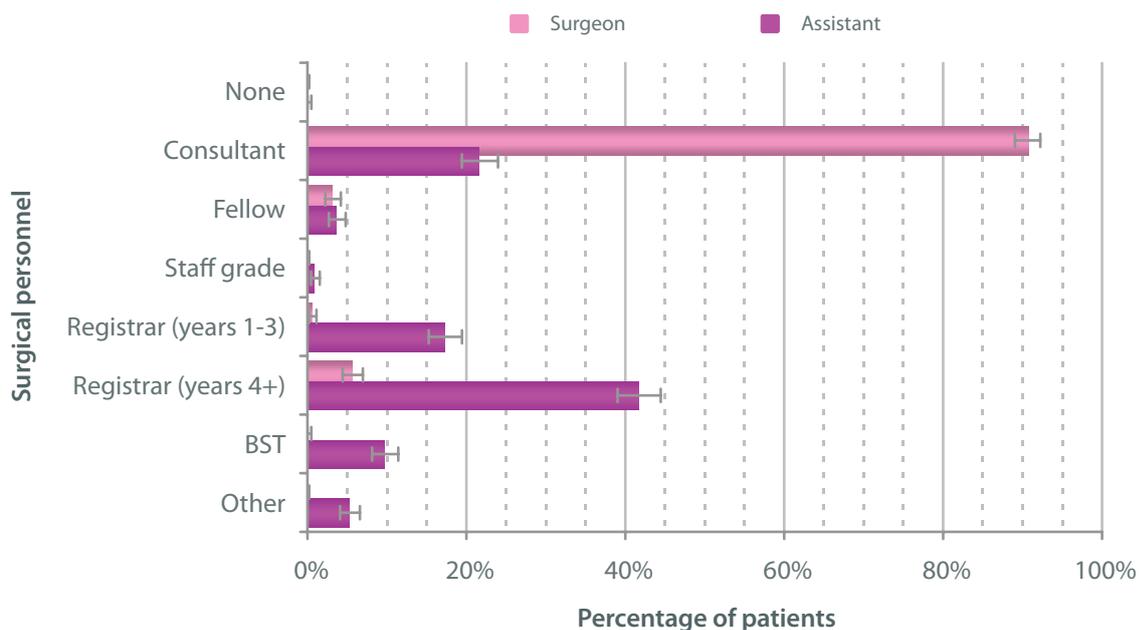
Adrenal surgery is clearly consultant-led, with a consultant being either principal surgeon or assistant in 96.6% of operations.

Where a consultant was primary surgeon and assistant was recorded, this assistant was also a consultant in 17.3% of operations. This might imply a significant degree of post-CCT training / mentoring of consultants in performance of adrenal surgery.

Adrenal surgery: surgical personnel

		Surgical personnel			
		Surgeon		Assistant	
		Count	Proportion	Count	Proportion
Operation type	None	0	0.0%	1	0.1%
	Consultant	1,207	90.8%	282	21.6%
	Fellow	41	3.1%	47	3.6%
	Staff grade	0	0.0%	11	0.8%
	Registrar (year 1-3)	7	0.5%	225	17.3%
	Registrar (year 4+)	74	5.6%	544	41.7%
	BST	1	0.1%	126	9.7%
	Other	0	0.0%	68	5.2%
	Unspecified	29		55	
	All	1,359		1,359	

**Adrenal surgery:
Most senior operating surgeon and assistant surgeon**

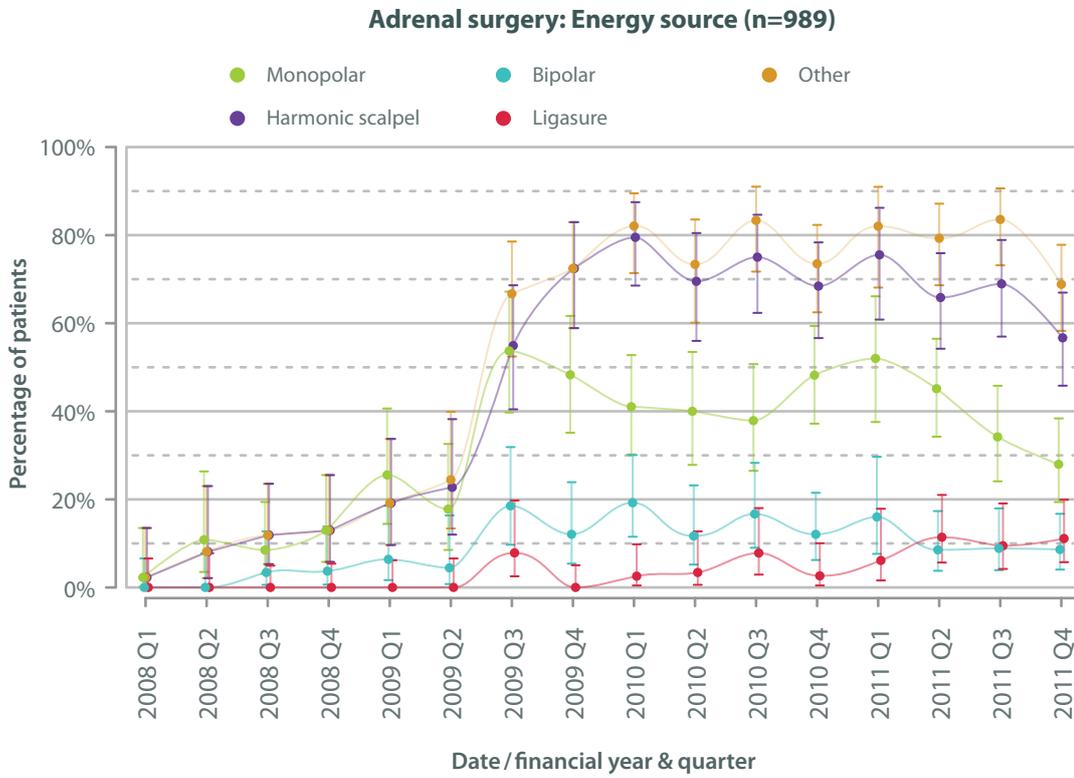




Energy source used

The majority of adrenal surgery is now carried out using *alternative* energy sources, principally the Harmonic scalpel, with a small more recent increase in use of the Ligasure device.

Surgery for adrenal disease







Outcomes

Post-operative stay

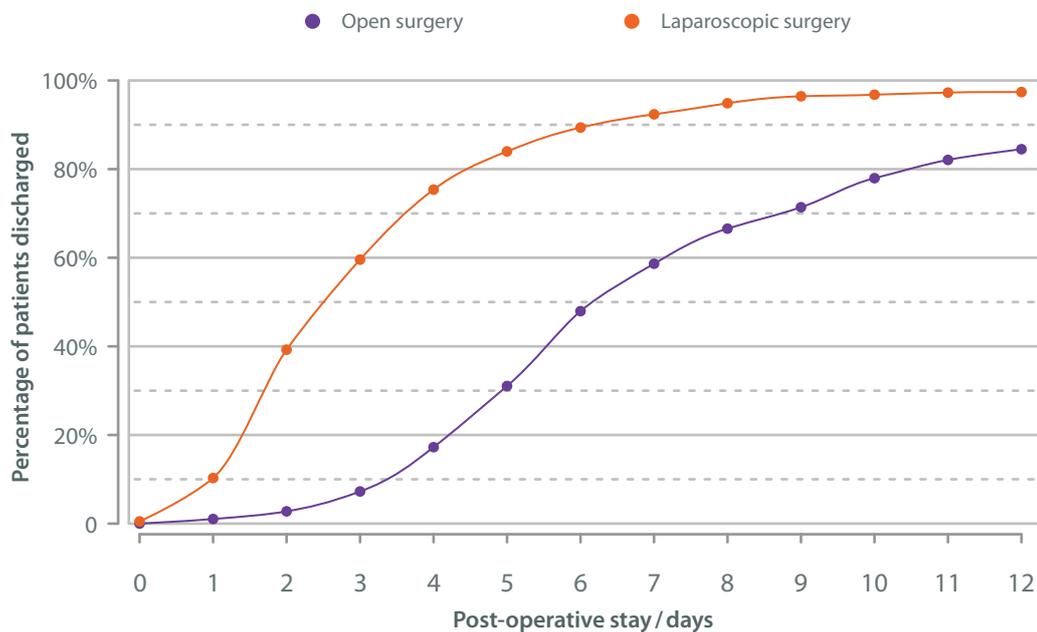
The principal determinant of length-of-stay after adrenal surgery is whether surgery is carried out laparoscopically or not.

The shortest stays are associated with non-functioning benign adenomas and with Conn's disease, as most are successfully treated laparoscopically. The remaining functional tumours have a higher conversion rate (detailed above), and open surgery is most frequent for carcinoma, hence the longer length-of-stay for these diagnoses.

Adrenal surgery: post-operative stay

		Post-operative stay			
		Count	Median days	IQR days	
Groupings	Diagnosis	Adenoma	112	3.0	2 - 5
		Carcinoma	67	7.0	5 - 10
		Conn's	181	2.0	2 - 3
		Cushing's	218	4.0	3 - 6
		Metastasis	60	4.0	2 - 7
		Phaeo	374	4.0	3 - 6
		Other	116	4.0	2 - 7
		Unspecified	3	4.0	3 - 6
		All	1,131	4.0	2 - 6
	Operation type	Open	213	7.0	5 - 10
		Laparoscopic	836	3.0	2 - 4
		Converted	77	7.0	5 - 10
		Unspecified	5	5.0	4 - 28
		All	1,131	4.0	2 - 6

Adrenal surgery: Patterns of post-operative stay (n=1,126)





Related readmission

Re-admission is reassuringly uncommon after adrenal surgery, and little difference exists between open and laparoscopic approaches.

Adrenal surgery: related readmission and operation type

		Related readmission			
		No	Yes	Unspecified	Rate
Operation type	Open	187	4	66	2.1% (0.7-5.6%)
	Laparoscopic	680	20	294	2.9% (1.8-4.5%)
	Converted	59	2	27	3.3% (0.6-12.4%)
	Unspecified	5	0	15	0.0% (0.0-45.1%)
	All	931	26	402	2.7% (1.8-4.0%)

Mortality

Mortality is also reassuringly low, with only 3 further deaths reported since the 2009 report:

- 7 deaths / 1,257 (another 102 unspecified) = 0.6% (95% CI: 0.2-1.2%).
- 4 male patients; 3 female patients.
- the patients were aged: 60, 61, 65, 67, 68, 69 and 70 years.
- the associated diagnoses were: Carcinoma ×1, Metastases ×1, Phaeo ×3, Other ×2.
- 2 procedures were open, 2 performed laparoscopically and 3 were *converted*.



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Surgery for endocrine pancreatic disease



Surgery for endocrine pancreatic disease

General information from the database

Number of members

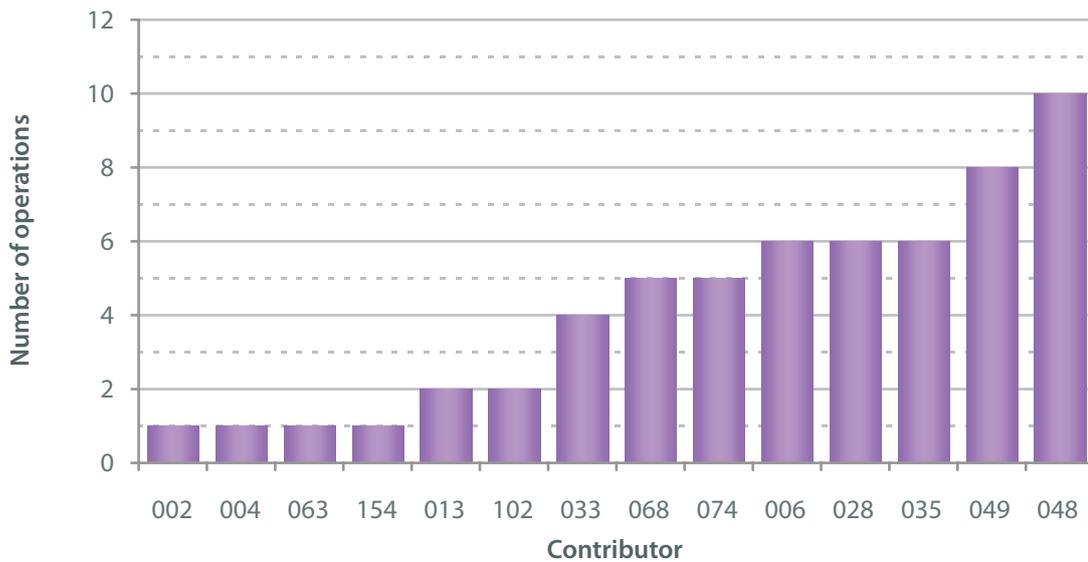
Only 7 operations for endocrine pancreatic disease have been added to the database since the 2009 report, with no member adding more than 2 cases.

The conclusions of this report are therefore very similar:

- Insulinoma was the commonest diagnosis.
- Around a third of cases were attempted laparoscopically, with a 10% conversion rate.
- Post-operative length-of-stay was shorter if surgery was performed laparoscopically.
- Short-term complications were not infrequent, particularly respiratory problems and pancreatic fistulae.
- However, mortality was zero.

Surgery for endocrine pancreatic disease

Pancreatic surgery: Number of operations reported by each member (n=58)





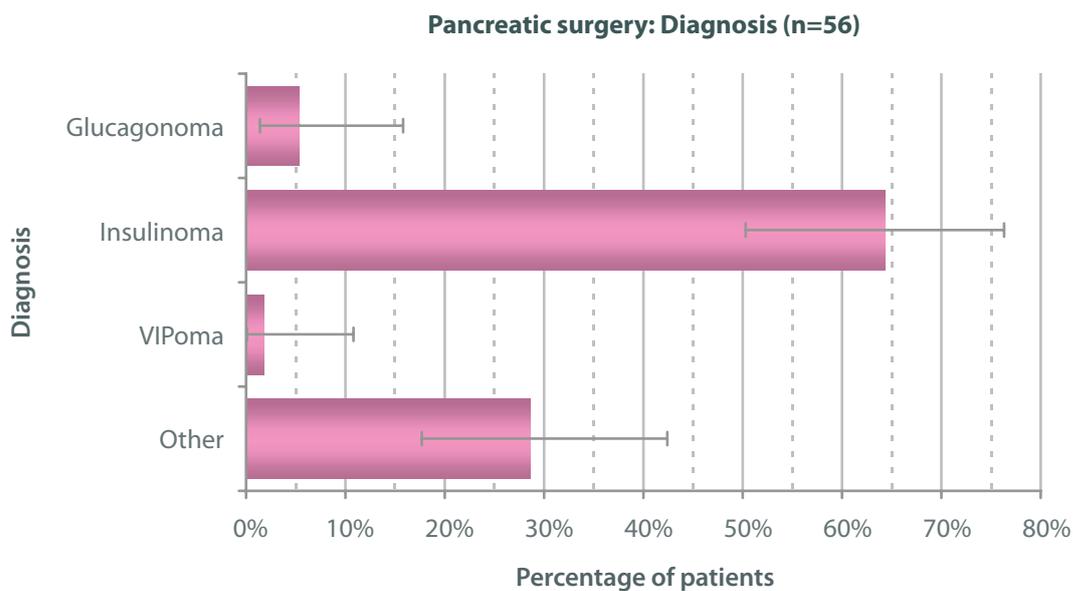
Demographics and disease profile

Diagnosis

As expected, insulinoma is the commonest diagnosis in pancreatic endocrine surgery.

Pancreatic surgery: diagnosis

		Data	
		Count	Rate (95% CI)
Diagnosis	Glucagonoma	3	5.4% (1.4-15.8%)
	Insulinoma	36	64.3% (50.3-76.3%)
	VIPoma	1	1.8% (0.1-10.8%)
	Other	16	28.6% (17.7-42.4%)
	Unspecified	2	
	All	58	





Operation

Type of operation

Six members 20 procedures with laparoscopic intent; conversion rate = 10.0%.

10 enucleation; 7 distal pancreatectomy; 2 Other (splenectomy, cholecystectomy).

Insulinoma (n=15): 66.7% (95% CI: 38.7-87.0%).

Pancreatic surgery: type of operation

		Data	
		Count	Rate (95% CI)
Type of operation	Open	37	64.9% (51.1-76.8%)
	Laparoscopic	18	31.6% (20.3-45.4%)
	Converted	2	3.5% (0.6-13.2%)
	Unspecified	1	
	All	58	

Surgeon

In all but three cases the most senior surgeon was a consultant. In the three cases where a Registrar (Year 4+) was the main operating surgeon a consultant was the assistant surgeon.



Outcomes

Crude in-hospital mortality

No deaths; 3 patients with unspecified status data.

No fistulae (in the *Fistula* question; 50/58 unknown) There are some data in the *Other complications* text field that suggest 4 patients have had a fistula (5 unknowns / 58 patients).

No pancreatitis (49/58 unknown).

No re-operations (4/58 unknown).

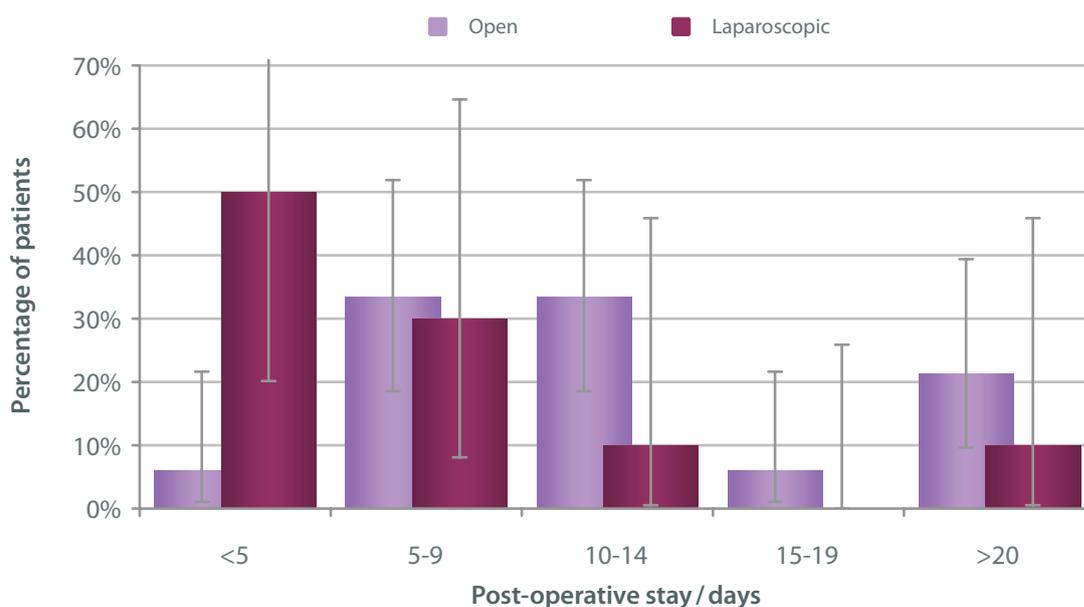
Post-operative complications: 53/58 known; 2 (3.8%) respiratory; 9 (13.2%) other (collection requiring drainage; fistula for 3 weeks; insulin-dependent diabetes; low volume pancreatic fistula; pancreatic fistula; port site cellulitis).

Post-operative stay

Pancreatic surgery: post-operative stay and type of operation

		Type of operation				
		Open	Laparoscopic	Converted	Unspecified	All
Post-operative stay / days	<5	1	5	1	0	7
	5-9	11	3	0	1	15
	10-14	11	1	0	0	12
	15-19	2	0	0	0	2
	>19	7	1	0	0	8
	Unspecified	5	8	1	0	14
	All	37	18	2	1	58

Adrenal surgery: Post-operative stay and type of operation (n=43)





Association

British



Appendices



Appendices

The database forms

Appendices

The British Association of Endocrine & Thyroid Surgeons
National database: Thyroid surgery
 Page 1; Version 2.1 (01/09/2010)

Demographics and other identifiers

baets identifier

Date of birth

Gender Male Female

Initial registry data

Procedure date

Date of operation

Pre-operative details

Main indication for thyroid surgery

- Thyrotoxicosis
- Compressive symptoms
- Quality of life
- Recurrent cyst
- Biopsy result
- Completion thyroidectomy for cancer
- Recurrent cancer
- Thyroglossal cyst
- Clinically worrying symptoms

Thyroid status at presentation

- Euthyroid
- Hyperthyroid
- Hypothyroid

Goitre type

- Cervical
- Retroclavicular
- Upper border AA
- Below AA

Pre-operative voice change No Yes

Pre-operative laryngoscopy No Yes

Re-operation No Yes

Re-operation same side as previous op No Yes

Number of previous operations

- One
- Two
- Three
- Four

FNAC No Yes

FNAC result

- Non-diagnostic
- Non-neoplastic
- Follicular lesions / neoplasia cannot be excluded
- Abnormal, suspicious of malignancy
- Malignant

MEN No Yes

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The British Association of Endocrine & Thyroid Surgeons
National database: Thyroid surgery
Page 2; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Thyroid procedure

Grade of principal surgeon

<input type="radio"/> Consultant	<input type="radio"/> Staff grade
<input type="radio"/> Registrar (year 4+)	<input type="radio"/> Fellow
<input type="radio"/> Registrar (year 1-3)	<input type="radio"/> Other
<input type="radio"/> BST	

Grade of assistant

<input type="radio"/> None	<input type="radio"/> BST
<input type="radio"/> Consultant	<input type="radio"/> Staff grade
<input type="radio"/> Registrar (year 4+)	<input type="radio"/> Fellow
<input type="radio"/> Registrar (year 1-3)	<input type="radio"/> Other

Previous contralateral lobectomy No Yes

Isthmusectomy alone No Yes

Side of thyroid procedure

<input type="radio"/> None	
<input type="checkbox"/> Left	<input type="checkbox"/> Right

Thyroid procedure: left

<input type="radio"/> Lobectomy	<input type="radio"/> Biopsy
<input type="radio"/> Sub / near total lobectomy	<input type="radio"/> Other

Thyroid procedure: right

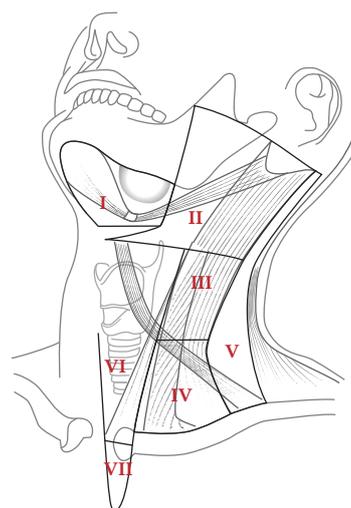
<input type="radio"/> Lobectomy	<input type="radio"/> Biopsy
<input type="radio"/> Sub / near total lobectomy	<input type="radio"/> Other

Node dissection: right

<input type="radio"/> None
<input type="checkbox"/> I
<input type="checkbox"/> II
<input type="checkbox"/> III
<input type="checkbox"/> IV
<input type="checkbox"/> V
<input type="checkbox"/> VI
<input type="checkbox"/> VII
<input type="checkbox"/> Biopsy only

Node dissection: right

<input type="radio"/> None
<input type="checkbox"/> I
<input type="checkbox"/> II
<input type="checkbox"/> III
<input type="checkbox"/> IV
<input type="checkbox"/> V
<input type="checkbox"/> VI
<input type="checkbox"/> VII
<input type="checkbox"/> Biopsy only





The British Association of Endocrine & Thyroid Surgeons

National database: Thyroid surgery

Page 3; Version 2.1 (01/09/2010)



baets identifier [input field]

Date of operation [input field: dd / mm / yyyy]

Thyroid procedure continued ...

Thyroid malignancy resectable	<input type="radio"/> No <input type="radio"/> Yes	<input type="radio"/> Not applicable
Thymectomy	<input type="radio"/> No	<input type="radio"/> Yes
Nerve monitoring used	<input type="radio"/> No	<input type="radio"/> Yes
Monitor	<input type="radio"/> Medtronic NM <input type="radio"/> Magstim	<input type="radio"/> Other
Other monitor	[input field]	
ET tube with integrated electrodes	<input type="radio"/> No	<input type="radio"/> Yes
Energy source used	<input type="checkbox"/> Monopolar diathermy <input type="checkbox"/> Bipolar diathermy	<input type="checkbox"/> Other
Other energy source used	<input type="radio"/> Bipolar scissors <input type="radio"/> Harmonic scalpel <input type="radio"/> Ligasure	<input type="radio"/> Lotus <input type="radio"/> Gyrus <input type="radio"/> Other
Other energy source	[input field]	

Thyroid pathology

Primary pathology	<input type="radio"/> Anaplastic cancer	<input type="radio"/> Hurthle cell adenoma
	<input type="radio"/> Auto-immune thyroiditis	<input type="radio"/> Hurthle cell carcinoma
	<input type="radio"/> C-cell hyperplasia	<input type="radio"/> Lymphoma
	<input type="radio"/> Colloid goitre	<input type="radio"/> Medullary thyroid cancer
	<input type="radio"/> Colloid adenoma	<input type="radio"/> Metastatic cancer
	<input type="radio"/> Follicular adenoma	<input type="radio"/> Papillary thyroid cancer
	<input type="radio"/> Follicular thyroid cancer	<input type="radio"/> Simple cyst
	<input type="radio"/> Graves' disease	<input type="radio"/> Other cancer
		<input type="radio"/> Other
	Other primary pathology	[input field]
Additional pathology	<input type="radio"/> Anaplastic cancer	<input type="radio"/> Hurthle cell carcinoma
	<input type="radio"/> Auto-immune thyroiditis	<input type="radio"/> Lymphoma
	<input type="radio"/> C-cell hyperplasia	<input type="radio"/> Medullary thyroid cancer
	<input type="radio"/> Colloid goitre	<input type="radio"/> Metastatic cancer
	<input type="radio"/> Colloid adenoma	<input type="radio"/> Papillary thyroid cancer
	<input type="radio"/> Follicular adenoma	<input type="radio"/> Simple cyst
	<input type="radio"/> Follicular thyroid cancer	<input type="radio"/> Other cancer
	<input type="radio"/> Graves' disease	<input type="radio"/> Other
	<input type="radio"/> Hurthle cell adenoma	
	Other additional pathology	[input field]



The British Association of Endocrine & Thyroid Surgeons
National database: Thyroid surgery
Page 4; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Thyroid cancer details

TNM staging

<input type="radio"/> T0	<input type="radio"/> T3	<input type="radio"/> N0	<input type="radio"/> M0 <input type="radio"/> M1
<input type="radio"/> T1a	<input type="radio"/> T4a	<input type="radio"/> N1a	
<input type="radio"/> T1b	<input type="radio"/> T4b	<input type="radio"/> N1b	
<input type="radio"/> T2	<input type="radio"/> TX	<input type="radio"/> NX	

Stage

<input type="radio"/> Stage I	<input type="radio"/> Stage III	<input type="radio"/> Stage IVB
<input type="radio"/> Stage II	<input type="radio"/> Stage IVA	<input type="radio"/> Stage IVC

Discussed at MDM before first operation No Yes

Discussed at MDM before after operation No Yes

Side of primary Right Bilateral
 Left

Thyroid discharge details

Re-operation for haemorrhage No Yes

Hypocalcaemia No Yes

Hypocalcaemia treatment given No Yes

Post-operative complications

<input type="radio"/> None	<input type="checkbox"/> Respiratory
<input type="checkbox"/> MI	<input type="checkbox"/> CVA
<input type="checkbox"/> DVT / PE	<input type="checkbox"/> Other

Other complication

Patient survival Alive Died in hospital

Date of discharge / death

Thyroid follow up

Date of follow up

Related re-admission No Yes

Date of readmission

Voice change No Yes

Voice cord check done Not done Normal Abnormal

Detail of abnormal voice cord check Recovered Persistent Pre-existing

Date of final voice cord check exam

Is the patient on T3 / T4 No Yes

Patient on Ca supplements or vitamin D No Yes



The British Association of Endocrine & Thyroid Surgeons

National database: Thyroid surgery

Page 5; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Comments

Patient comment

Database comment



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The British Association of Endocrine & Thyroid Surgeons
National database: Parathyroid surgery
Page 1; Version 2.1 (01/09/2010)



Demographics and other identifiers

baets identifier

Date of birth

Gender Male Female

Initial registry data

Parathyroid investigations and pathology

Pre-operative cord check No Yes

Venous sampling Negative Not done
 Positive

Nuclear medicine Negative Not done
 Positive

PET Negative Not done
 Positive

Ultrasound Negative Not done
 Positive

Gamma probe Negative Not done
 Positive

CT / MRI Negative Not done
 Positive

Methylene blue Negative Not done
 Positive

Primary pathology Sporadic Familial HPT
 MEN Carcinoma

Renal pathology Normocalcaemia Dialysis
 Hypercalcaemia Post-transplant
 Medical Rx alone

Parathyroid operation

Date of operation

Grade of principal surgeon Consultant Staff grade
 Registrar (year 4+) Fellow
 Registrar (year 1-3) Other
 BST

Grade of assistant None BST
 Consultant Staff grade
 Registrar (year 4+) Fellow
 Registrar (year 1-3) Other



The British Association of Endocrine & Thyroid Surgeons

National database: Parathyroid surgery

Page 2; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Parathyroid procedure continued ...

Number of glands removed 0 1 2 3 3.5 4

Is this a re-operation No Yes

Number of previous operations One Two Three Four

Location of tumour Eutopic Ectopic neck Ectopic chest

Targeted approach No Yes

Converted to conventional No Yes

qPTH measured No Yes

Supernumary No Yes

Nerve monitoring used No Yes

Monitor Medtronic NM Magstim Other

Other monitor

ET tube with integrated electrodes No Yes

Parathyroid discharge details

Re-operation for haemorrhage No Yes

Hypocalcaemia No Yes

Hypocalcaemia treatment given No Yes

Post-operative complications None MI DVT / PE Respiratory CVA Other

Other complication

Patient survival Alive Died in hospital

Date of discharge / death



The British Association of Endocrine & Thyroid Surgeons
National database: Parathyroid surgery
Page 3; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Parathyroid follow up

Date of follow up

Persisting hypercalcaemia No Yes

Related re-admission No Yes

Date of readmission

Voice change No Yes

Voice cord check Not done Negative
 Positive

Details of abnormal voice cord check Recovered Persistent Pre-existing

Date of final voice cord exam

Patient on Ca supplements or vitamin D No Yes

Comments

Database comment

Patient comment



The British Association of Endocrine & Thyroid Surgeons

National database: Adrenal surgery

Page 1; Version 2.1 (01/09/2010)



Demographics and other identifiers

baets identifier

Date of birth

Gender Male Female

Initial registry data

Adrenal investigations and pathology

Adrenal diagnosis Conn's Cushing's Phaeo Adenoma Carcinoma Metastasis Other

Other adrenal diagnosis

Adrenal anatomy Left Right Bilateral Extra-adrenal

Malignant No Yes

MEN No Yes

Maximum diameter by radiology

Adrenal operation

Date of operation

Grade of principal surgeon Consultant Registrar (year 4+) Registrar (year 1-3) BST Staff grade Fellow Other

Grade of assistant None Consultant Registrar (year 4+) Registrar (year 1-3) BST Staff grade Fellow Other

Adrenal operation type Open Laparoscopic Converted

Adrenal operation approach Transperitoneal Posterior

Energy source used Monopolar diathermy Bipolar diathermy Other

Other energy source used Bipolar scissors Harmonic scapel Ligasure Lotus Gyrus Other

Other energy source



The British Association of Endocrine & Thyroid Surgeons
National database: Adrenal surgery
Page 2; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Adrenal discharge details

Re-operation for haemorrhage No Yes

Post-operative complications None Respiratory
 MI CVA
 DVT / PE Other

Other complication

Patient survival Alive Died in hospital

Date of discharge / death

Adrenal follow up

Date of follow up

Related re-admission No Yes

Date of readmission

Comments

Patient comment

Database comment



The British Association of Endocrine & Thyroid Surgeons

National database: Pancreatic surgery

Page 1; Version 2.1 (01/09/2010)



Demographics and other identifiers

baets identifier

Date of birth

Gender Male Female

Initial registry data

Pancreas investigations and pathology

Pancreas diagnosis Insulinoma VIPoma
 PPoma Somatostatinoma
 Glucagonoma Other

Other pancreas diagnosis

MEN No Yes

Pancreas operation

Date of operation

Grade of principal surgeon Consultant Staff grade
 Registrar (year 4+) Fellow
 Registrar (year 1-3) Other
 BST

Grade of assistant None BST
 Consultant Staff grade
 Registrar (year 4+) Fellow
 Registrar (year 1-3) Other

Pancreas operation type Open Converted
 Laparoscopic

Pancreas procedure Enucleation Total pancreatectomy
 Distal resection Other
 Right-sided pancreatectomy

Other pancreas procedure

Energy source used Monopolar diathermy Other
 Bipolar diathermy

Other energy source used Bipolar scissors Lotus
 Harmonic scapel Gyrus
 Ligasure Other

Other energy source



The British Association of Endocrine & Thyroid Surgeons
National database: Pancreatic surgery
Page 2; Version 2.1 (01/09/2010)



baets identifier

Date of operation

Pancreas discharge details

Patient survival Alive Died in hospital

Date of discharge / death

Pancreas follow up

Date of follow up

Related re-admission No Yes

Date of readmission

Comments

Patient comment

Database comment



Notes



Notes



Notes



Notes



Notes



Notes



Notes

A national audit of patients undergoing endocrine surgery

Measures of clinical outcomes are set to gain increasing importance in the political agenda of the National Health Service. In the United Kingdom Government's recent Health and Social Care Bill it is stated that:

There will be a relentless focus on clinical outcomes.

Improvements in healthcare outcomes will be the central purpose of the NHS.

There will be ability to link quality measures in national clinical audits to payment arrangements.

Clinicians will be mandated to collect information on their clinical activity as part of medical revalidation, for which process the GMC advise all doctors to take part in regular and systematic audit.

Patients also rightly expect surgeons to examine and reflect upon their results, with the aim of ensuring high-quality surgical care.

The BAETS has remained committed to audit over a period of many years, operating since 2000 a national audit of outcomes for patients undergoing surgery for thyroid, parathyroid, adrenal and endocrine pancreatic disease. This fourth report of the national audit details the ongoing progress made in recording surgical outcomes and refining analysis of those factors that influence them. The outcome measures under scrutiny remain highly relevant, being clinically important for patients and directly linked to the skill of the individual surgeon. Participation in the audit continues to increase over time, and the results provide many valuable insights into the investigation, treatment and outcomes of endocrine surgical diseases.

The report contains much that will be of interest to surgeons, patients, clinical commissioners, regulatory bodies and NHS Trusts, and demonstrates the readiness of the BAETS for a new era of emphasis on clinical outcomes in the NHS.



Mr David Chadwick
The British Association of Endocrine & Thyroid Surgeons
Department of Surgery
Chesterfield Royal Hospital
Calow, Chesterfield
S44 5BL
United Kingdom

phone +44 (0) 1246 513 197
fax +44 (0) 1246 512 313
email david.chadwick@chesterfieldroyal.nhs.uk

www.baets.co.uk



Dr Peter K.H. Walton
Dendrite Clinical Systems
Managing Director
The Hub, Station Road
Henley-on-Thames
Oxfordshire RG9 1AY
United Kingdom

phone +44 (0) 1491 411 288
fax +44 (0) 1491 411 377
email peter.walton@e-dendrite.com

www.e-dendrite.com