

# The logistical management of tertiary urethral disease in the United Kingdom: Implications from an online audit of male reconstructive urethral surgery

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## Abstract

**Objective:** To determine those patient groupings, based on volume and risk, whose optimal urethral reconstructive management might be provided by a reorganisation of UK reconstructive surgeons.

**Methods:** Between 2010 and 2017, ~689 men/year were enrolled onto an online audit platform collecting data about urethral reconstruction in the UK; this accrual was compared against hospital episode statistics (HES). The available workforce, and where this was based, was collected. Individual and institutional incumbent patient volumes, pathology, surgical complexity and outcomes from treatment were collated to stratify volume/risk groups.

**Results:** More than 90% of all HES-recorded data were accrued, being provided by 50 surgeons at 39 operative sites. Most reconstructive surgery was provided at 10 centres performing >20 procedures/year. More than 50% of all interventions were of a high-volume low-risk type. Of activity, 32.3% was intermediate volume or moderate risk, and 12.5% of men presented for lower-volume or higher-risk procedures.

**Conclusion:** Correlation of detailed volume/outcome data allows the definition of patient populations presenting for urethral reconstruction. Stratification of each group's management, to optimise the surgical outcome, may be applied to a hierarchical service delivery model based on the complexity of the patient's presenting urethral pathology.

**Level of evidence:** Level IV

## Keywords

Urethral reconstruction, organisation, volume, risk, service delivery model

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## Introduction

In a free at the point of need healthcare economy, provision of complex services in a sustainable, value for money (VFM) way is difficult to achieve. Data are key to understanding the volumes and complexities of patient populations requiring intervention. Until now, this could only be achieved by counting men with urethral pathology undergoing surgical treatments, using Hospital Episode Statistics

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(HES<sup>1</sup>). HES is used in England to provide retrospective annual returns based on inpatient-based International Classification of Diseases 10<sup>2</sup> and Office of Population Censuses and Surveys (OPCS)<sup>3</sup> codes; these are gathered at the point of discharge from a National Health Service hospital. The original remit of HES was to provide managerial, planning and contracting information, with the only demonstrable measure of outcome being death, readmission and length of stay (LOS). None of these parameters are sensitive indicators relevant to patients with benign pathologies. Surprisingly, bearing in mind these caveats, extrapolations from HES returns and published retrospective data from international single centres of excellence have been used as the basis for strategic planning of complex benign clinical services such as urethroplasty.<sup>4</sup>

By comparison, detailed clinically derived data, accrued from the British Association of Urological Surgeons (BAUS) 7-year longitudinal audit of tertiary reconstructive urology,<sup>5</sup> has provided much greater, clinically relevant insight into the volumes and outcomes of patients having reconstructive urethral surgery in the UK. The BAUS data sets facilitate the delineation of high-volume low-risk patient populations, and the identification of intermediate- and low-volume and moderate- to high-risk groups, who may require more specialist reconstructive interventions to try and achieve better long-term outcomes. This paper seeks to integrate the incident urethral pathologies and their outcomes from reconstruction<sup>5</sup> with the surgical services currently available, so as to define volume/risk populations and an acceptable, best fit structure for future service delivery of urethral reconstruction.

## Material and methods

Surgeon-derived data obtained from the online, encrypted Nuvola/Dendrite software system, previously described,<sup>5</sup> were analysed over a 7-year period from June 2010 to June 2017. Data were collected about where, when and by whom data were entered, from a series of single options and free-text strings, in 95 fields with 283 variables.

The reporting data for centres and individuals were compared against HES returns for OPCS codes M73.3–73.9, for an index period between 2014 and 2016. Delay in accessing surgical treatment was used to indicate the ease of access to reconstructive urology. The operating surgeon's grade was noted and indications of outcome from treatment were inferred from the LOS, intra- and post-operative complications, post-operative symptoms and objective evidence of early recurrence of urethral stricture or fistulae, or failure of adult hypospadias repair.

## Results

### Demographics

In total, 4809 new data entries (a mean of 687 per year) were made on the online platform. Patient information

came from 39 centres and 50 surgeons; a median of 32 surgeons reported in each of the 7 years audited with data field completeness of 70.7%. Comparison with HES returns, during the index period, showed ~90% concordance between the BAUS and HES databases; one centre's data accrual appeared to be a significant outlier, being poorly represented regarding BAUS data whilst contributing > 20 procedures/year via HES.

Three centres reported 49.5% of all data and 9 centres 74.2%. Geographically, 82% of reported activity was carried out in four areas; 42% of operations were performed in London, 15.1% east of the Pennines, 13.3% west of the Pennines and 11.9% in the South of England. Only 3.7% of all reconstructive surgery was performed in Scotland, Wales, or Northern Ireland; there were no returns from Eire.

The median number of all procedures recorded/surgeon/year across all centres was 18.8. However, this figure was very significantly skewed by the volume of activity carried out by surgeons working in centres completing > 20 procedures/year (Figure 1: bar chart); 10 operative centres carried out > 20 procedures/year (range 21–153). The number of surgeons carrying out urethral reconstruction, over 7 years, marginally increased in centres carrying out > 20 and < 10 procedures annually (Figure 1: line chart). However, only 11 surgeons carried out > 20 procedures/year (range 20–98).

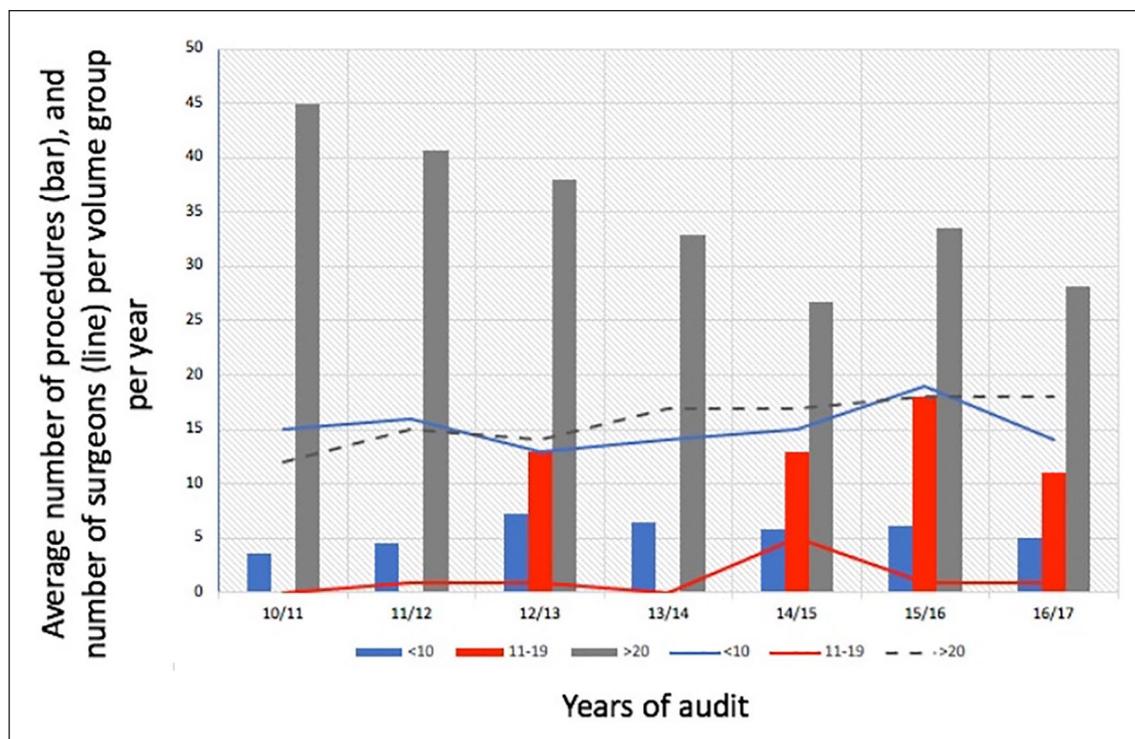
In total, 3058 follow-up records were audited (a mean of 437/year, giving a new:follow-up ratio of 1:0.64), with data field completeness of 53.7%. Follow-up data came from 34 centres and 39 surgeons; 50.5% of all follow-up returns were recorded from the three highest-reporting centres. This level of data detail, in addition to the follow-up ratio, reduces the confidence of any inferences that can be made from the analysis of outcome.

### Access to, and provision of, tertiary urethral surgery

Of 3594 men, 87.4% proceeded to operation without a delay in management; 6.2% of men requested deferral of their treatment for personal reasons and 4.2% had their surgery delayed because of logistical problems at the tertiary centre.

**Stricture surgery.** Surgery was undertaken by the managing consultant in 90.3% of 3705 operations, and by supervised trainees operating 6.8% of the time; mentored consultants and unsupervised trainees carried out the remaining procedures.

Of 3662 stricture operations, 79% were performed in a single stage by 48 of the 50 surgeons returning data. A median of 6.8 cases were operated on per surgeon per year (range 0.23–60.8 per surgeon per year). Thirty-three operators (60% of all returning surgeons) carried out the 21% multi-stage operations with median return rates of 1.8



**Figure 1.** The average number of procedures carried out per surgeon, dependent upon the annual operative centre volume, and the number of surgeons contributing to the surgical workloads in those centres between 2010 and 2017 (groupings: < 10, 11–19 and > 20 procedures/year).

**Table 1.** The surgical procedures performed on 3493 men with documented operations for urethral stricture disease, and the numbers of surgeons carrying out the procedures.

| Operative procedure                       | Surgical variant | Number of cases | Surgeons performing |
|---|------------------|-----------------|---------------------|
| Bladder neck reconstruction               |                  | 31              | 3                   |
| Bulbo-prostatic anastomosis               |                  | 188             | 19                  |
| Bulbar urethroplasty                      | Anastomotic      | 599             | 35                  |
|   | Augmentation     | 1406            | 40                  |
| Peno-bulbar urethroplasty                 |                  | 209             | 23                  |
| Penile urethroplasty                      | Single stage     | 198             | 30                  |
|   | Multi-stage      | 340             | 23                  |
| Navicular fossa and meatal reconstruction | Single stage     | 105             | 19                  |
|   | Multi-stage      | 316             | 23                  |
| Perineal urethrostomy                     |                  | 101             | 11                  |

cases/year (range 0.16–24.6 per surgeon per year). The surgical interventions documented as being undertaken and the surgeon numbers undertaking those procedures are shown in Table 1.

Anterior urethral surgery, of the bulb, peno-bulbar segment or penile urethra, irrespective of underlying pathology,

constituted 73% of all reconstructive surgery; this was carried out by the majority of reporting surgeons. Posterior urethroplasty was performed by 19 consultants in 14 hospitals; however, 72.6% of bulbo-prostatic urethroplasty for pelvic fracture urethral injury (PFUI) was performed in two of the three highest-reporting centres.

**Table 2.** The surgical procedures performed on 255 men with urethral fistula and for previously untreated adult hypospadias, and the number of surgeons carrying out these procedures.

| Operative procedure                | Anatomical site | Number of cases | Surgeons performing |
|------------------------------------|-----------------|-----------------|---------------------|
| Fistula surgery                    | Posterior       | 61              | 10                  |
|                                    | Anterior        | 95              | 16                  |
| Untreated adult hypospadias repair |                 | 99              | 21                  |

**Table 3.** Length of stay data for 3832 men with urethral pathology and the percentages of cases of lengths of stay greater than the mean.

| Pathology             | Cases | Mean length of stay (days) | Length of stay range (days) | Cases of length of stay > mean |
|-----------------------|-------|----------------------------|-----------------------------|--------------------------------|
| Stricture             | 3643  | 1.99                       | 0–156                       | 16%                            |
| Fistula               | 105   | 1.5                        | 0–10                        | 29.7%                          |
| Untreated hypospadias | 84    | 2.84                       | 0–22                        | 26%                            |

**Fistula surgery.** Fistula surgery was recorded as being carried out on 156 men at 15 locations by 20 surgeons (Table 2), with 53.6% of all activity coming from two of the three highest-reporting centres. A median of 1 fistula repair/year was recorded in centres returning data (range 0.14–8.6 per year per surgeon).

Repair of fistulae following previous hypospadias surgery was carried out in 15 hospitals by 16 surgeons, with 50% of data recorded from two of the three largest-reporting centres. The median number of interventions for post-hypospadias fistula repair was 0.71 per surgeon per year (range 0.14–2.43) over the audit period.

Complex posterior urethral fistula and bladder neck surgery was carried out by only 10 surgeons, with the majority of operations being carried out by 1 surgeon.

**Untreated adult hypospadias surgery.** Ninety-nine men with untreated hypospadias had documentation of correction at 18 units by 21 surgeons (Table 2), with a median intervention of 0.28 cases/year (range 0.14–4.7); one surgeon was recorded as carrying out 36% of all operations during the audit.

### Outcome of interventions

**Lengths of stay (LOS).** The means and ranges of LOSs are seen in Table 3, together with the percentages of procedures exceeding the average LOSs reported.

The mean LOS for all urethral reconstruction was low (< 3 days), although there was significant variation in range. For stricture disease, the LOS related to surgical practice, with some centres keeping patients in hospital, as a standard, for  $\leq 7$  days. Longer stays following fistula repair were all influenced by LOSs related to posterior fistula reconstruction.

### Subjective and objective benefits from surgery

**Stricture disease.** Overall symptomatic improvement and patient satisfaction rates were > 90% from all centres following anterior urethroplasty; there was tremendous variability in complication accrual between sites. This meant that high-volume centres (HVCs), who had higher data completion rates, appeared to have higher complication rates than lower-volume centres who recorded less assiduously. However, there was no significant variation in the incidence of complications proportionate to the volumes of surgery performed in the HVCs.

Post-operative urinary and sexual symptoms were most common, and complication rates were highest, in patients having bladder neck reconstruction in the two centres carrying out this surgery. Higher complication rates were also seen in the 19 centres performing posterior urethroplasty or surgery for fall astride injury.

Poor urine flow rates and early recurrence were, again, highest in patients having bladder neck reconstruction, after surgery for PFUI or following reconstruction of fall astride injuries. In the anterior urethra, early stricture recurrence rates were most prevalent following second-time revisional hypospadias repair, for peno-bulbar strictures > 7 cm associated with lichen sclerosis and after single-stage penile, meatal or navicular fossa reconstructions.

**Fistula surgery.** In total, 82.8% of men were followed up after fistula surgery.

There was a dramatic improvement in satisfaction with penile cosmesis after anterior urethral fistula repair. Of 69 men, 25% had post-operative complications, including a recurrent fistula incidence of 5.5%.

There was a 43.8% complication rate recorded following posterior urethral fistula closure and 18.7% had fistula recurrence in the seven centres performing this surgery.

**Table 4.** The surgical populations of 4096 men, presenting for reconstruction dependent upon the type of surgery performed or their presenting pathology/aetiology, together with their complication and recurrence rates, within 3 months of surgery, contributing to their derived risk groups.

| Patient population   | Total patient volume (%) | Complication rate (%) | Recurrence rate (%) | Volume/risk profile  | Risk group |
|--|--------------------------|-----------------------|---------------------|--|------------|
| First time, bulbar/peno-bulbar/penile urethroplasty <sup>a</sup>       | 55.2                     | < 2.5                 | < 2                 | High volume, low risk of complications, good outcome   | HVLR       |
| Lichen sclerosis urethroplasty   | 14.7                     | 14.2                  | 12.2                | Moderate volume, intermediate complication rate, high revision rate                                  | IVMR       |
| Post-hypospadias reconstructions                                       | 13                       | 17.4                  | 14.2                | Moderate volume, intermediate complication rate, moderate outcome, high revision rate                |            |
| Anterior urethral fistula repair                                       | 2.2                      | 25.3                  | 5.5                 | Low volume, high complication rate, reasonable outcome   |            |
| Posterior urethroplasty and complex trauma reconstruction <sup>b</sup> | 10.7                     | 18.9                  | 10.2                | Moderate volume, intra-operation complication risk, intermediate complication rate, moderate outcome | LVHR       |
| Primary adult hypospadias repair                                       | 2.4                      | 14.3                  | 11.8                | Low volume, intermediate complication rate, moderate outcome   |            |
| Posterior urethral fistula   | 1                        | 46                    | 40                  | Very low volume, high reintervention rate for AUS insertion  |            |
| Bladder neck stenosis surgery  | 0.8                      | 24                    | Unknown             | Very low volume, High complication rate, unknown outcome   |            |

AUS: artificial urinary sphincter; HVLR: high volume or low risk; IVMR: intermediate volume or moderate risk; LVHR: low volume or higher risk.

<sup>a</sup>Non-lichen sclerosis or hypospadias-related surgery.

<sup>b</sup>This does not include surgery for stricture recurrence.

The majority of the complications recorded were due to incontinence; this could have been anticipated as many in this group were awaiting planned insertion of an artificial urinary sphincter. Sexual function, both pre- and post-operation, was very poorly documented.

**Untreated adult hypospadias repair.** Only 21.8% of men had documented follow-up following primary hypospadias repair and of these, spraying or post-micturition dribbling occurred in one-third. No new sexual dysfunction was seen in this group and there was very significant improvement in patient satisfaction with penile cosmesis following surgery, wherever it was performed. Objectively, 11.8% of men developed a fistula following distal urethral reconstruction following primary hypospadias repair.

### Definition of volume/risk categories

Information about post-operative complications, and the risks of stricture, fistula recurrence, or failed hypospadias repair, facilitates the definition of a number of patient sub-populations.<sup>5</sup> These can be stratified as either high-, intermediate- or low-volume or risk procedures, dependent

upon their frequency of presentation, chance of complication, risk of failure or need for reintervention (Table 4).

### Discussion

This audit, of  $\leq 90\%$  of a country's reconstructive urethral surgery, has demonstrated that the majority of reported surgical activity is undertaken by consultant surgeons performing  $> 20$  procedures a year. However, there is still a large number of surgeons carrying out reconstructive procedures on a much more sporadic basis.

At the present time, the follow-up rate from the study does not support conclusive evidence of a significant relationship between volume and outcome in the open surgical management of urethral disease. Whilst there is no direct link between volume and outcome, we have been able to integrate the incidence of presenting urethral pathologies with the global outcomes from surgery to reconstruct them. We have shown previously<sup>5</sup> that comorbidity has no impact on surgical complication rates or clinical outcomes, so patient-related clinical factors do not seem to be of especial relevance to the organisation of reconstructive services. However, the pathology/volume and outcome

data<sup>5</sup> for men with urethral disease facilitate the stratification of reconstructive interventions across the UK. High-volume or low-risk, intermediate-volume or moderate-risk, and low-volume or high-risk patient groups have been derived as a consequence of this data. Integration of the available workforce with the incumbent patient populations, to deal with this specialist workload, helps provide a clinically relevant structure for service provision on a nationwide basis for men requiring open urethral intervention for the future.

For training<sup>6,7</sup> and workforce-planning purposes, and to maintain the quality and continuity of service delivery, it seems responsible to maintain the current numbers of consultants undertaking complex urethral reconstructions.<sup>8</sup> Of course, this assumes there is no unpredicted change in demand for any reason. Concentration of special expertise in a limited number of centres to provide quality diagnostics, nursing expertise and informed post-operative care for complex patient groups has been shown to help productivity,<sup>9</sup> although the precise economic benefits of this process have been less easy to define.<sup>10</sup> A high-volume patient concentration is known to benefit patient outcomes in other areas of complex oncological urology,<sup>11–14</sup> and has been demonstrated to have outcome benefits in benign surgery in other disciplines.<sup>15,16</sup> Although there often seems to be resistance to the process of centralisation,<sup>9</sup> it appears that its acceptability to patients, particularly as far as the need to travel for both outpatient evaluation and inpatient care is concerned, is outweighed by the perceived clinical benefit.<sup>17–19</sup> Therefore, the distance between tertiary or quaternary centres is not a major factor that inhibits the adoption of regional or supra-regional network structures.

These data suggest that surgeons expressing an interest in reconstructive genito-urethral surgery might be consolidated into a hub and spoke, or surgical 'in-reach', structure, such as has become a paradigm for urological oncological service provision in the UK.<sup>20</sup> A central, ideally multi-consultant, hub might coordinate a multi-disciplinary team meeting for peer case review, with associated 'spoke' centres providing high-volume surgical activity for less-complex clinical problems. The hub could aim to provide a comprehensive inpatient environment treating more complex lower-volume, or recurrent, urethral pathologies, or those with higher complication and reintervention rates. This environment would also provide enhanced training exposure for future reconstructive surgeons,<sup>7,8</sup> condensing operative experience to a limited group of specialist surgeons, and hopefully optimising patient outcomes.<sup>21</sup> Ultra-low-volume or significantly complex clinical problems might have their management centralised on a supra-regional or even a national basis, as a tier above the central hub environment. High-volume or low-risk 'spoke' surgeons could then provide operative treatment for higher-volume, first-time penile, peno-bulbar and bulbar strictures, either at their base hospital or by 'reaching into the hub'.

The hubs might provide intermediate volume or moderate risk interventions for recurrent, post-hypospadias repair and long lichen sclerosis-related strictures, in addition to less complex work, providing a comprehensive service.

Based upon our data, it would be prudent to consider those centres with surgeons performing > 20 procedures/year as hubs. Three or four totally comprehensive, supra-regional low-volume or higher-risk centres, possibly including two in London, might be designated from within those geographically located hubs as providers of primary adult hypospadias repair, complex trauma-related stricture surgery, and the evaluation and reconstruction of iatrogenic posterior urethral fistulae, bladder neck repair and complex revisional hypospadias work. The specific logistics regarding such a reconfiguration require definition, especially in view of the BAUS database's incomplete information from all UK centres. However, in the current, commissioned healthcare environment in the UK, it would seem sensible for decisions about the provision of complex or highly complex surgery to be based on detailed clinical, rather than managerially-derived, data.<sup>4</sup> Complex reconstructive services should be structured around the incumbent subpopulations of patients requiring urethral reconstruction, dependent upon volume and risk.

## Conclusions

Data from national, clinically based data systems provide greater levels of patient-relevant information for planning tertiary services than HES, and facilitate the derivation of a volume/risk classification for reconstructive procedures. A stratification of service delivery could be derived from this classification that might include a hub and spoke, or 'in-reach', organisational structure, dependent upon pathological or surgical complexity. Improvements in future audits should aim to enhance the quality of outcome data collection to refine individual surgeon and centre performance, and help delineate 'value for money' in service delivery.

## Conflicting interests

The authors declare that there is no conflict of interest.

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## Ethical approval

Ethical approval was not sought for the present study because this was an audit of established practice.

## Informed consent

Informed consent was not sought for this study because secure, totally anonymised data were collated and analysed.

## Guarantor

SRP

## Contributorship

SRP and ARM researched the literature, and conceived the audit on behalf of the British Association of Genito-Urethral Reconstructive Surgeons (BAGURS). They were both involved in audit protocol development and SRP performed data collation. SRP and SF were responsible for data analysis. SRP wrote the first draft of the manuscript. All authors reviewed and edited the manuscript, and approved the submitted final version.

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