



CONGENITAL CARDIAC SURGERY REPORT

April 2007 – March 2010

Foreword

I am pleased to introduce the surgical data for the Bristol Congenital Cardiac Service from April 2007 – March 2010, which demonstrates continued excellent outcomes.

The service goes from strength to strength, with attention to the very highest governance standards of quality and safety and the introduction of innovative practice.

We look forward to the challenge of building further on this success and through designation, growing the programme and giving us the opportunity to deliver safe, high quality, equitable care to an even wider group of children.

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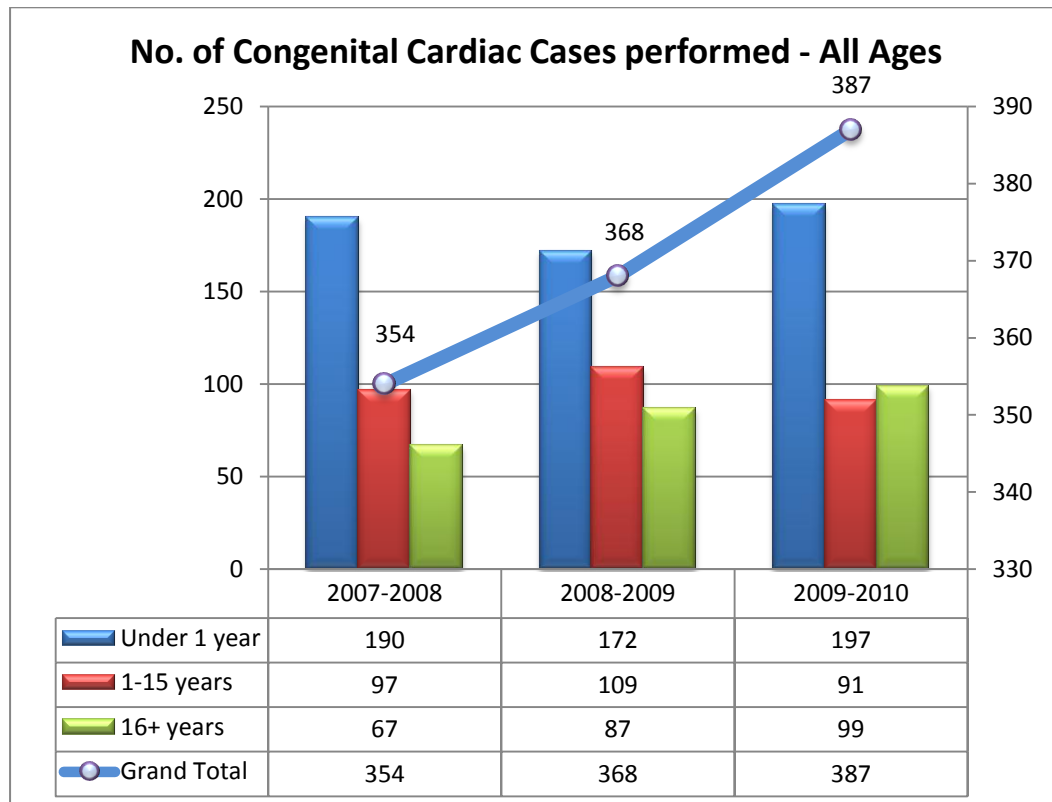
INTRODUCTION

This report presents in detail the activity and results of the congenital cardiac surgical service for the financial years 2007-2010. All data for the current year (2009-2010) has been internally validated and submitted to the Central Cardiac Audit Database (CCAD) www.ccad.org.uk who will be validating the data independently throughout the next calendar year. In previous years, the internal validation of the data presented within this report has been verified by CCAD.

SURGICAL ACTIVITY

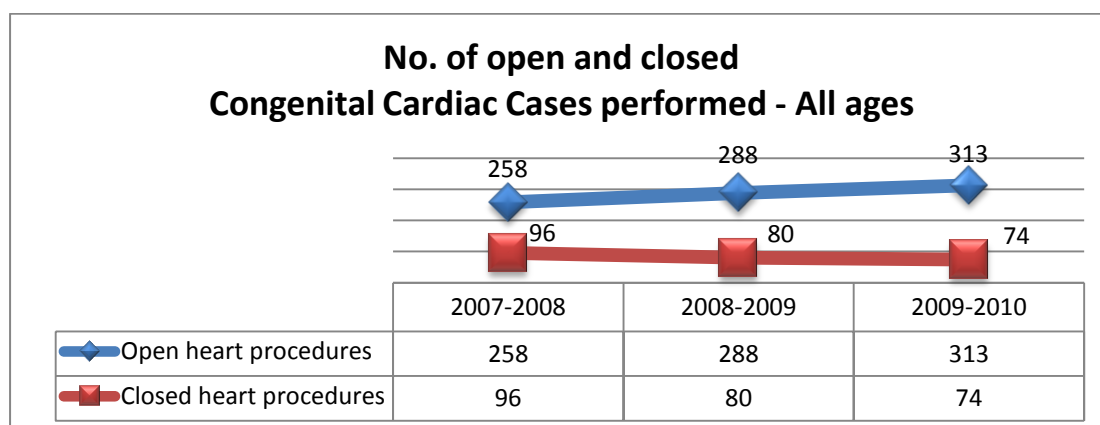
In the past three years, April 2007 to March 2010, the number of operations performed has increased year on year, from 354 to 387 (an increase of 9.32%). The breakdown in activity by patient age and year is as shown in Figure 1. Patients aged under 16 years were treated in the Bristol Royal Hospital for Children. All patients aged over 17 years were admitted to Bristol Royal Infirmary (BRI), or the new Bristol Heart Institute (BHI) from May 2009. Between the ages of 16 and 17, depending on family/patient preference and appropriateness of the care environment, patients were managed at either the Children's Hospital or BRI/BHI.

Figure 1.



Of these operations, 859 were open, meaning the heart-lung bypass machine was required to perform them, and 250 were closed, not requiring the use of the heart-lung bypass machine (Figure 2). Most of the closed cases (85.2%) were performed in children aged under one. During this period, the proportion of closed cases performed has fallen from 27% to 19% overall, 42% to 31% in children aged under one. This reflects our move away from a policy of staged palliation to primary repair in children with a two-ventricle circulation.

Figure 2.



DEMOGRAPHIC DATA

Of the patients treated, 50.9% were male and 49.1% female. 38.14% of patients had a Welsh postcode.

RISK STRATIFICATION

Operative risk is dependent on many factors. These include urgency of surgery (operative priority), age and size at the time of operation, pre-operative status, the number of previous operations, the complexity of the underlying cardiac anomaly, and the procedure being performed. These risk factors are considered individually and data from the current year has been compared with the previous years' data. Direct comparison with other UK centres is not possible within this timeframe due to the limited data available. The most robust data available comes from the Central Cardiac Audit Database (CCAD) initiative as all the data is independently validated. However, there is a time lag due to the process of validation and currently only data up to 2006-2007 is available.

When comparing figures from a single institution with national data, care must be exercised due to the potential for bias (in either population or institution) in the frequency and management of high-risk patients which may skew a surgeon's or institution's results. This is of particular relevance in the neonatal

group, where the most complex and difficult patients require surgical management. In order to obtain meaningful comparisons with national data, we have reviewed those surgical procedures undertaken frequently where the patient population requiring treatment is relatively uniform and clear national comparative data are available.

OPERATIVE PRIORITY¹

Operative priority was categorised according to accepted definitions. The bulk of the workload for each year is elective, with 36-45% of all procedures being urgent or emergency operations and 55-64% elective (Table 1).

Table 1.

Priority of procedure all ages (2007 to 2010)

	2007-2008		2008-2009		2009-2010	
	No. Cases	% Total	No. Cases	% Total	No. Cases	% Total
Under 16 years						
Elective	142	49.48%	147	52.31%	165	57.29%
Urgent	133	46.34%	124	44.13%	106	36.81%
Emergency	12	4.18%	10	3.56%	17	5.90%
Under 16 years Total	287	100%	281	100%	288	100%

	2007-2008		2008-2009		2009-2010	
	No. Cases	% Total	No. Cases	% Total	No. Cases	% Total
Over 16 years						
Elective	54	80.60%	79	90.80%	84	84.85%
Urgent	11	16.42%	6	6.90%	13	13.13%
Emergency	2	2.99%	2	2.30%	2	2.02%
Over 16 years Total	67	100%	87	100%	99	100%

¹ Elective – routine admission from 'waiting list'

Urgent – patients requiring surgery during current admission for medical reasons

Emergency – patients requiring surgery within 24 hours of emergency admission

AGE VERSUS OPERATIVE PRIORITY

Within the population of patients with congenital heart disease requiring surgery we continue to see a significant difference between age groups in the balance of elective to urgent or emergency cases (Table 2). The majority of procedures undertaken in neonates are urgent, whereas the majority of procedures undertaken in children aged over one year or in the adult population are elective. This reflects the fact that children with complex congenital cardiac disease and/or duct dependent circulation present early in life. For some infants, irreversible changes can occur early in the heart and lungs, even within the first few weeks or months of life, and surgery must therefore be undertaken promptly.

Table 2.

Priority of case load by age and category

Financial year 2007-08

Age Category	Elective		Urgent		Emergency	
	No. cases	% Age	No. cases	% Age	No. cases	% Age
Neonate	1	1.67%	56	93.33%	3	5.00%
Infant	54	41.54%	69	53.08%	7	5.38%
Child	87	89.69%	8	8.25%	2	2.06%
16+	54	80.60%	11	16.42%	2	2.99%
Total cases	196	55.37%	144	40.68%	14	3.95%

Financial year 2008-09

Age Category	Elective		Urgent		Emergency	
	No. cases	% Age	No. cases	% Age	No. cases	% Age
Neonate	2	3.77%	48	90.57%	3	5.66%
Infant	50	42.02%	64	53.78%	5	4.20%
Child	95	87.16%	12	11.01%	2	1.83%
16+	79	90.80%	6	6.90%	2	2.30%
Total cases	226	61.41%	130	35.33%	12	3.26%

Financial year 2009-10

Age Category	Elective		Urgent		Emergency	
	No. cases	% Age	No. cases	% Age	No. cases	% Age
Neonate	8	10.67%	59	78.67%	8	10.67%
Infant	75	61.48%	41	33.61%	6	4.92%
Child	82	90.11%	6	6.59%	3	3.30%
16+	84	84.85%	13	13.13%	2	2.02%
Total cases	249	64.34%	119	30.75%	19	4.91%

NUMBER OF OPERATIONS - INCLUDING CURRENT PROCEDURE

In the under one year age group over this time, 15% had previously undergone surgery (Figure 3); this is consistent with our results for previous years. Most of those patients who underwent more than one operation were on a pathway of staged palliation for their cardiac problem. It is our policy to perform second stage palliation for single ventricle defects at four to six months of age, and complete correction for two ventricle morphologies at six to eight months of age. For children aged between one and 16 years, 27% had previously undergone at least one cardiac surgical procedure (Figure 4).

Figure 3

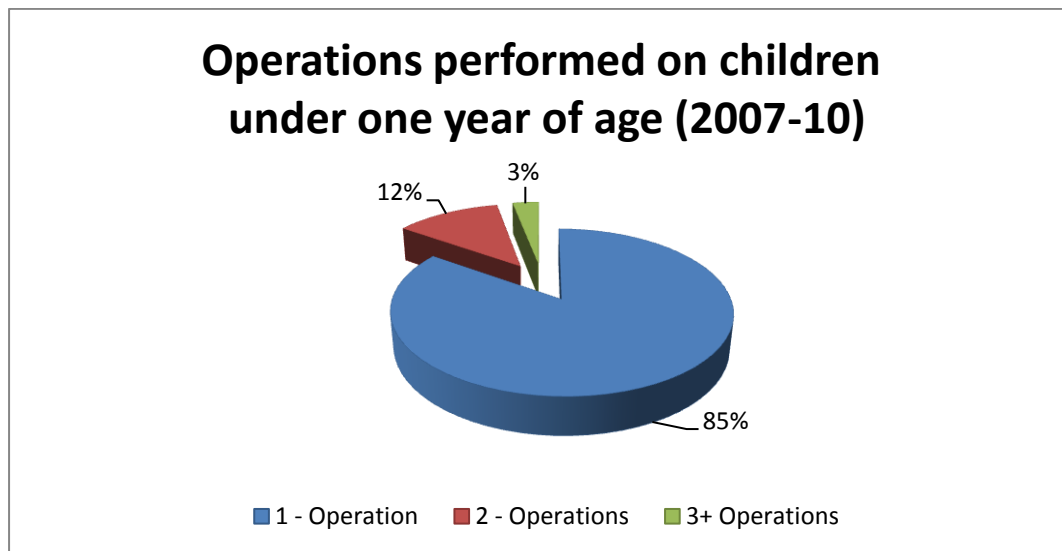
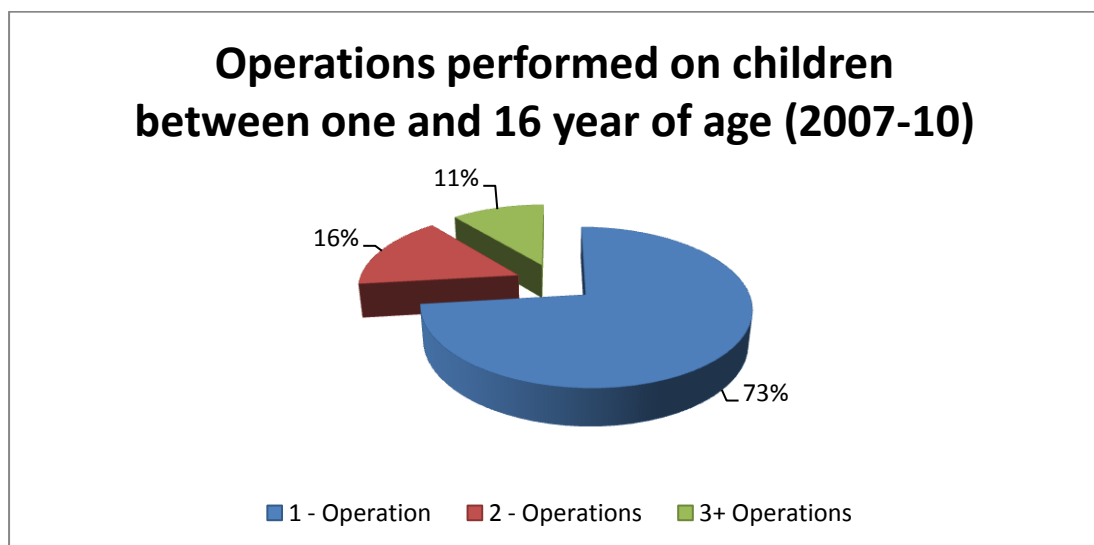


Figure 4



SURGICAL OUTCOME

As priority of the procedure, the complexity of surgery, and the number of previous operations have previously been shown to be independent predictors of outcome after surgical procedures, surgical outcome is presented below with these considerations. All data relate to the initial operative procedure performed; for patients requiring re-operation for a residual lesion during the same hospital stay, outcome is attributed to the primary procedure. This is the same premise on which the Central Cardiac Audit Database (CCAD) – visit <http://www.ccad.org.uk/congenital> for more information – reporting is based and data should therefore accurately reflect the risk of surgery for any particular congenital cardiac lesion. In this section, deaths are recorded if they occurred within 30 days of surgery or during the primary hospital stay - whichever is the shorter.

MORTALITY VERSUS PRIORITY OF PROCEDURE

Any operation which is necessary as an urgent or emergency procedure is associated with an increased risk as there is less time available to stabilise the child, and the deleterious effects of the defect cannot be completely alleviated before intervention is required. The more urgent the surgery, the sicker the child is and the less time is available to prepare the child for surgery. This is reflected in the outcomes. Overall mortality for the years 2007-2010 was 1.2% for elective cases, 1.3% for urgent cases, and 6.7% for emergency cases (Table 3).

Table 3.

Mortality by priority of procedure all ages (2007-10)

Age Group	Priority	No. of cases	No. deaths	% Mortality
Under 1 year	Elective	190	3	1.6%
	Urgent	337	4	1.2%
	Emergency	32	2	6.3%
Under 1 year Total		559	9	1.6%
1-15 years	Elective	264	1	0.4%
	Urgent	26	1	3.8%
	Emergency	7	1	14.3%
1-15 years Total		297	3	1.0%
16+ years	Elective	217	4	1.8%
	Urgent	30	0	0%
	Emergency	6	0	0%
16+ years Total		253	4	1.6%
Total overall		1109	16	1.4%

MORTALITY VERSUS COMPLEXITY OF SURGERY

Operations for congenital heart disease are divided into 'closed' (those not requiring the use of a heart-lung bypass machine) and 'open' (those requiring bypass) operations. 'Open' cases are further divided into 'simple' or 'complex'. Increased complexity surgery is associated with increased risk (Table 4).

Table 4.

Mortality by operation type all ages (2007-10)

Financial year	operation type	No. cases	No. deaths	% mortality
2007-2008				
	Closed	96	4	4.2%
	Open/Simple	67	0	0.0%
	Open/Complex	191	3	1.6%
2007-2008 Total		354	7	2.0%
2008-2009				
	Closed	80	0	0.0%
	Open/Simple	102	0	0.0%
	Open/Complex	186	3	1.6%
2008-2009 Total		368	3	0.8%
2009-2010				
	Closed	74	1	1.4%
	Open/Simple	126	2	1.6%
	Open/Complex	187	3	1.6%
2009-2010 Total		387	6	1.6%

As is demonstrated below (Table 5), the majority of open heart procedures in neonates were not only urgent but also complex.

Table 5.

Age and type of operation (2007-10)

	Closed		Open/Complex		Open/Simple	
	No. cases	No. deaths within 30 days	No. cases	No. deaths within 30 days	No. cases	No. deaths within 30 days
Neonate	91	1	82	2	15	0
Elective	4	0	6	0	1	0
Urgent	78	1	72	2	13	0
Emergency	9	0	4	0	1	0
Infant	122	2	146	2	103	2
Elective	19	1	85	1	75	1
Urgent	97	1	54	0	23	0
Emergency	6	0	7	1	5	1
Child	27	1	158	2	112	0
Elective	17	0	140	1	107	0
Urgent	10	1	15	0	1	0
Emergency			3	1	4	0
16+	10	1	178	3	65	0
Elective	7	1	153	3	57	0
Urgent	2	0	21	0	7	0
Emergency	1	0	4	0	1	0
Total overall	250	5	564	9	295	2

MORTALITY VERSUS NUMBER OF OPERATIONS INCLUDING CURRENT PROCEDURE

As indicated previously, many patients with congenital heart disease will require multiple cardiac surgical procedures. Due to the normal healing process, scar tissue forms around the heart which must be dissected through at all further operations; the greater the number of operations the thicker the scar tissue. The risk of subsequent operations should therefore increase. Further, those patients requiring multiple cardiac surgical procedures are usually those with more complex anomalies. Previous cardiac surgery is therefore recognised as being associated with an increased risk for subsequent procedures. From our own data the only single year which fulfils this prediction is 2009-2010, while from the overall data for the three years the mortality for first, second, and third operations is 1.29%, 2.39%, and 1.07% respectively (Table 6).

Table 6.

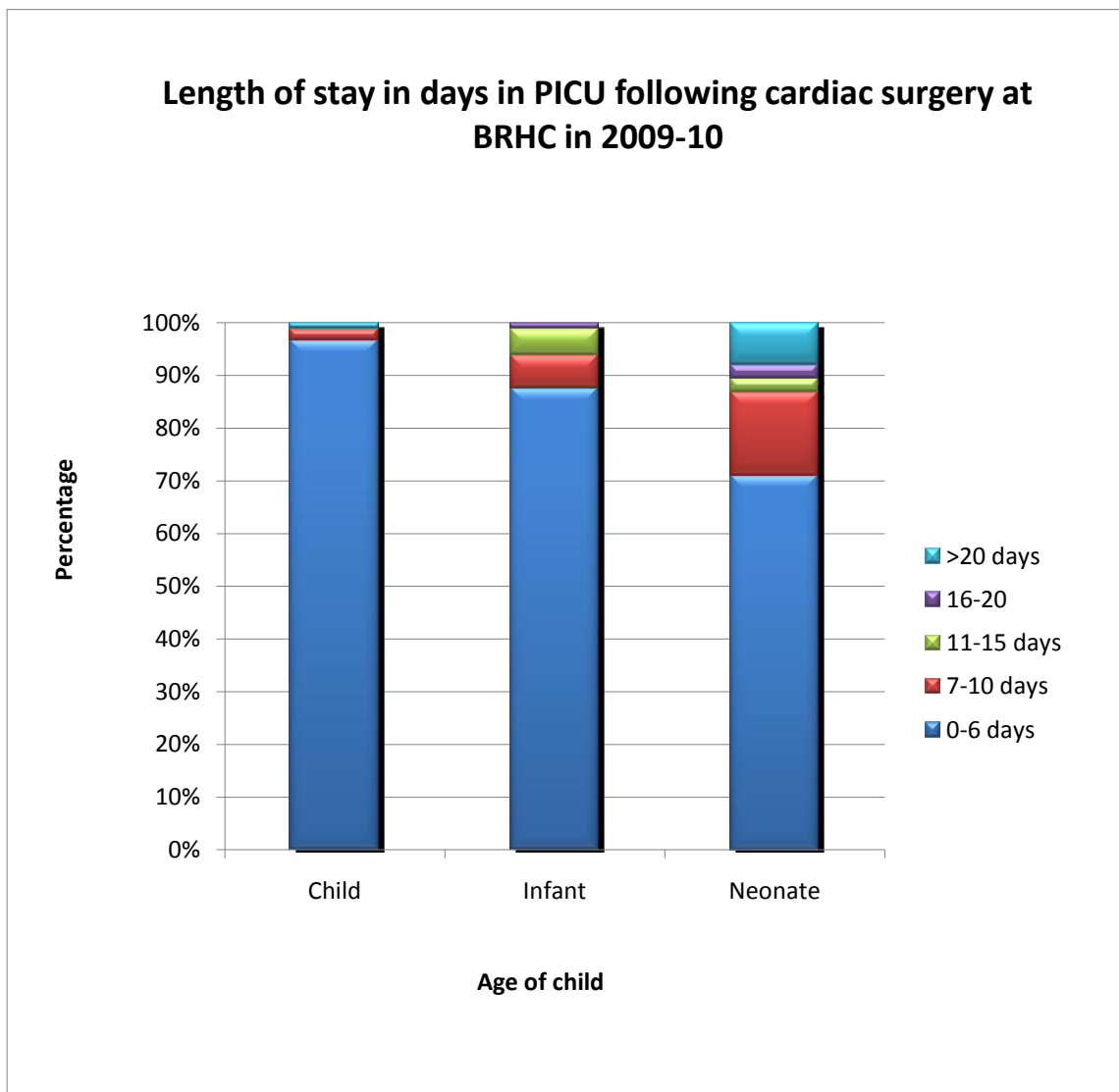
Mortality by number of operations - open and closed (all ages)

Financial year	Operations performed	No. cases	No. deaths	% mortality
2007-2008				
	1 Operation	261	6	2.3%
	2 Operations	60	1	1.7%
	3+ Operations	33	0	0.0%
2008-2009				
	1 Operation	282	1	0.4%
	2 Operations	53	2	3.8%
	3+ Operations	33	0	0.0%
2009-2010				
	1 Operation	306	4	1.3%
	2 Operations	54	1	1.9%
	3+ Operations	27	1	3.7%

POST OPERATIVE RECOVERY AND HOSPITAL STAY

The duration of intensive care required following cardiac surgery depends on the severity of the heart disease (and therefore also the complexity of the surgery performed) and the preoperative status of the child. As could be predicted from this, the neonatal group had the longest Paediatric Intensive Care Unit (PICU) stay with a median post-operative stay of three days, compared to two days for infants and one day for children (Figure 5).

Figure 5.



SURGICAL DATA – CASE MIX AND PATIENT SELECTION

As patients and parents strive to ensure that their surgery or that of their child is performed only in a centre where the results are good, it is not uncommon for results from different surgical units to be compared. This exercise must, however, be undertaken with great care due to inherent bias potentially present within the data. The prime factors in this consideration are case mix and patient selection. If coarse data simply compared without appreciating the complexity of the case mix, a very biased conclusion could be reached: a centre doing only low-risk procedures would appear to be performing better than one in which all procedures, including the very high risk cases, were being treated. Similarly, for two centres offering the same surgical procedures, if one centre refused to treat patients considered to be ‘high risk’, this centre would appear ‘better’ than the other in which all patients underwent surgery.

The identification of national ‘benchmark’ procedures has been an attempt to minimise confounding factors and to allow fairer comparison between centres. However, the type and number of procedures identified as ‘benchmark procedures’ are limited and make up less than 50% of the surgical workload. In Table 7 we report categories of congenital cardiac surgical procedures which are undertaken in sufficient number with a patient profile of predictable complexity to allow reasonable comparison.

In order for further comparison of overall mortality data with other units to be valid we need to address any potential concerns that our cases are somehow less complex or different from other centres. Over the last year, after 10 years of preparation and training, we started a programme for the surgical treatment of patients with hypoplastic left heart syndrome. Therefore, we now offer surgery for every congenital heart defect². The results we publish reflect our experience with all these children. Further, all children, except those with co-existent, lethal, extra cardiac abnormalities, are offered treatment in our unit.

² We do not perform heart transplantation

BENCHMARK PROCEDURES

As previously referred to, in 1998 the Society of Cardiothoracic Surgeons of Britain and Ireland proposed that an individual surgeon's performance should be continually monitored through selected 'benchmark' procedures. Six were identified: ASD closure, VSD closure, repair of complete AV septal defect, correction of Tetralogy of Fallot, arterial switch procedure in 'simple' transposition and repair of coarctation. Data for our unit for these common benchmark procedures and other common abnormalities are presented in Table 7.

Table 7.

Benchmark procedures

	2007-2008		2008-2009		2009-2010	
	cases	Deaths	cases	Deaths	cases	Deaths
Closed heart procedures						
CoA	35	1	21	0	26	0
PDA	22	1	30	0	27	0
Closed heart procedures Total	57	2	51	0	53	0
Open heart procedures						
ASD	27	0	35	0	30	0
ASO	23	0	21	0	13	0
CAVSD	11	0	10	0	11	0
Fallot	20	0	25	0	25	0
Fontan	10	1	5	0	5	0
Norwood					7	0
PAVSD	5	0	12	0	9	0
Truncus	1	0	3	0	2	0
VSD	41	0	37	0	43	0
Open heart procedures Total	138	1	148	0	145	0
Grand Total	195	3	199	0	198	0

Key of abbreviations:

CoA	Repair of aortic coarctation
PDA	Ligation of persistent ductus arteriosus
ASD	Closure of atrial septal defect
ASO	Arterial switch operation
CAVSD	Repair of complete AV septal defect
Fallot	Repair of Tetralogy of Fallot
PAVSD	Repair of partial AV septal defect
Truncus	Repair of truncus arteriosus
VSD	Closure of ventricular septal defect

"This report demonstrates that Bristol continues to meet the challenges of new and innovative techniques in congenital heart surgery. These results are testimony to the dedication of the whole clinical network, from early and accurate diagnosis to the necessary teamwork in the theatre and intensive care arenas, as well as the support following discharge home by our colleagues in Cardiff and the peripheral hospitals in the South West and South Wales."

Mr Andrew Parry

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May 2010

Acknowledgements

I would like to thank José Velázquez, information and data manager, and Mike Wakelam, information analyst, at Bristol Royal Hospital for Children for their efforts in assisting with data acquisition, data analysis and the preparation of this report.

