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VeriQ system for assessing graft flow during coronary artery bypass graft surgery (MTG8)

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Project Details

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Glossary of Terms

CABG	Coronary Artery Bypass Graft
EAC	External Assessment Centre
IABP	Intra-Aortic Balloon Pump
MI	Myocardial Infarction
NICE	National Institute for Health and Care Excellence
TTFM	Transit Time Flow Measurement or Transit Time Flowmeter

1. Background

The MiraQ systems (MiraQ Cardiac, MiraQ Vascular, MiraQ Ultimate) are used to assess the quality of blood flow during vascular, cardiac and transplantation procedures to ensure graft patency. The technology allows surgeons to correct grafts with poor blood flow during the initial surgery reducing the need for repeat interventions. A cost analysis of the use of the instrument (previously called VeriQ) in Coronary Artery Bypass Grafting was originally submitted by the manufacturer and appraised by KCARE in 2010. KiTEC subsequently undertook a revised cost analysis in 2016 to inform guidance on the use of the instrument issued by the National Institute for Health and Care Excellence (NICE). A further request for an update of the cost analysis has been received.

Each of the 3 systems is available in 2 versions. The basic models measure transit time flow measurement (TTFM) which allows accurate measurement of blood flow through a blood vessel. In addition, each system is available in a version which includes a modality for ultrasound imaging of blood vessels (Table 1). Versions supporting ultrasound imaging are considerably more expensive. This report considers the basic version of the Miraq Cardiac (MQC02001) which supports TTFM but not ultrasound imaging, and has a list price of £34,000. The instrument requires probes which range in size from 1.5mm to 7.0mm and all cost £1,481 each. These sterilisable probes can be used 50 times, giving an average cost per probe use of £29.62. Note that the cost of sterilising the probes between uses has not been considered.

Table 1. Functional channels

System	Flow	ECG/AUX display	Ultrasound imaging
MQC12001	2	1	1
MQC02001	2	1	none

2. Analysis

The revised cost analysis undertaken in 2016 has been re-revised with updated unit costs. In the original analysis a cost per patient scanned was estimated on the basis of the instrumentation cost (purchase cost of the MiraQ MQC02001 system, the service cost and the probe cost), the impact on theatre time of measuring TTFM and the downstream impact on the costs of graft revisions. We retained the original assumption that the system has a working life of 10 years and would be used for surgery on 220 patients per year. We also retained the assumption of an annual service costing £1,800 per annum and commencing in the third year after purchase of the instrument. The purchase cost and the service costs have been annuitized over 10 years at an interest rate of 3.5%. Dividing the resulting annual cost by an estimated number of patients per year (220) generates a system cost of

£24.90 per patient. In addition to the system cost, measuring TTFM requires the use of a probe. We maintained the previous assumption of a probe lifespan of 50 uses and a requirement of a mean of 1.7 probes used per patient scanned. Based on the list price of a probe of £1,481, this generates a cost of £50.35 per patient for probes. The total cost per patient scanned is then £75.25.

Table 2. Updated NHS reference costs

Category	Original costs	Updated costs for 2016	Updated costs for 2017	Source of updated costs for 2017
Actual or Suspected Myocardial Infarction	£1,415.20	£1,814.80	£1,773.29	NHS reference costs 2016 (average of EB10A, EB10B, EB10C, EB10D, EB10E)
Rehab for acute MI and other cardiac disorders	£251.76	£237.55	£257.78	NHS reference costs 2016 (VC38Z)
Deep sternal infection, intermediate without clinical complications	£860.55	£1,080.69	£1119.98	NHS reference costs 2016 (WH07G)
Proxy for IABP	£2,657.37	£2,866.00	£2,574.38	NHS reference costs 2016 (average of EC20A, EC20B)

The costs related to complications that may be reduced by MiraQ were updated again (Table 2). The original costs were taken from NHS reference costs 2009-10 and then updated using NHS reference costs 2014-15. The re-revised costs are taken from NHS reference costs for 2015-16. While costs for rehabilitation following acute MI and the costs of treating a deep sternal infection have increased, the costs of MI and IABP have decreased.

Table 3. Updated labour costs

Category	Original costs (per hour)	Updated costs (per hour) for 2017 base case	Updated costs (per hour) for 2017 sensitivity analysis	Source of updated costs for 2017
Cardiac surgeon	£68.54	£138	£337	PSSRU 2016 (hospital based surgical consultant)
Anaesthetist	£41.90	£128	£312	PSSRU 2016 (Associate specialist)
Cardiac nurse	£23.37	£51	£124	PSSRU 2016 (hospital based band 6 nurse including qualifications)
Cardiac perfusionist	£24.17	£60	£146	PSSRU 2016 (hospital based band 7 nurse including qualifications)

Labour costs were also re-examined (Table 3). The original submission used NHS salaries adjusted for various on-costs such as national insurance contributions, pension contributions and vocational training costs. In the previous revision these costs were replaced with hourly costs taken from the Unit Costs of Health and Social Care for 2015 (PSSRU 2015), which is accepted as an authoritative source of costs for health and social care staff in the UK. The replacement costs accounted for salary, salary on-costs, qualification costs, ongoing training, capital costs and facility overheads.

We revisited these costs using the latest edition of the Unit Costs of Health and Social Care for 2016 (PSSRU 2016). The additional costs incurred through the extension of theatre time are dependent on whether they impact on the operating list and reduces the number of operations performed. Where they do not reduce the number of operations performed the cost might reasonably be limited to the additional time for the surgical staff approximated using the cost per working hour of the staff. Where the theatre list is impacted costs are higher, and might more reasonably be approximated by the cost per patient contact hour of the staff. We applied a cost per working hour in the base case. In sensitivity analysis we applied a cost per patient contact hour. Costs per patient contact hours were unavailable for doctors. We assumed the same ratio of direct to indirect time of 1:1.44 which was used to generate the cost per patient contact hour for nurses (essentially we scaled up cost per working hour by the same factor). We included of qualification costs for all staff.

As previously, the surgical team was assumed to consist of two cardiac surgeons, two cardiac nurses, an anaesthetist, and a cardiac perfusionist. We also retained the previous assumptions whereby: a

unit cost for a consultant surgeon was applied to the cardiac surgeons; a unit cost for an associate specialist was applied to the anesthetist; cardiac nurses were assumed to be on the Agenda for Change band 6 pay grade; cardiac perfusionists were assumed to cost the same as a nurse on the Agenda for Change band 7 pay grade.

We undertook sensitivity analysis in which we varied the following parameters: duration of TTFM procedure per minute; mean number of probes per procedure: proportion of patients requiring revisions; duration of minor revisions; duration of major revisions; proportion of revisions which are minor; re-operative procedure costs; reduction of rate of re-operative procedures with TTFM; cost of deep sternal infection; reduction of rate of deep sternal infection with TTFM; cost of IABP; reduction of rate of IABP with TTFM; cost of MI; reduction of rate of MI with TTFM. Finally we undertook sensitivity analysis in which we assumed theatre staff included only one surgeon and one cardiac nurse rather than two of each.

Results

Table 4 presents the results of the base case analysis using costs per working hour for theatre staff and the sensitivity analysis which used costs per patient contact hour for theatre staff.

Table 4. Updated individual level base-case results and sensitivity analysis

	Updated results for 2017 (base case)		**Updated results for 2017 (sensitivity analysis with staff costed per patient contact hour)**	
	Using VeriQ TTFM	**Clinical assessment**	**Using MiraQ TTFM**	**Clinical assessment**
Graft assessment	£114.98	£0.00	£172.13	£0.00
Operative issues	£42.36	£298.37	£42.36	£298.37
Total cost per patient	£157.34	£298.37	£214.48	£298.37
Savings	**£141.03**		**£83.89**	

After updating, the total average saving when using MiraQ is £141.03 per patient in the base case. In sensitivity analysis this saving falls to £83.89, but MiraQ remains cost saving. These results are similar to the findings of the previous cost update in 2016 which reported a cost saving for MiraQ of £95.42.

The number of CABG procedures performed each year has been falling in recent years, partly due to substitution with percutaneous coronary interventions. However, over the five year period 2010-2014 the number of CABGs performed appears to have stabilised at around 17,000 per year (British Heart Foundation 2017). On the basis of the average number of CABGs per year reported by the British Heart Foundation for the years 2010-2014 (17,443), the adoption of MiraQ could save the NHS £2.5million.

The results of sensitivity analysis in which input parameters were varied are reported in Table 5 below. In all cases except one MiraQ remained cost saving. The one exception was the sensitivity analysis in which we assumed no difference in the risk of IABP with or without TTFM. In this scenario, MiraQ was slightly more expensive.

Table 5. Sensitivity of results to changes in parameter values.

Parameter	Base case value	Lower value	Cost saving for MiraQ	Upper value	Cost saving for MiraQ
Duration of TTFM (min)	2.35	2	144.33	5	116.03
Probes per procedure	1.7	1.4	110.93	2	65.78
Patients with revisions (%)	6.58	2.2	152.73	14.6	119.64
Minor revision duration (min)	2.5	2	141.14	5	140.49
Major revision duration (min)	42	27	147.11	57	134.95
Minor revision proportion (%)	34.7	20	137.42	50	144.78
Re-operative procedure cost (£)	180.41	90.21	141.03	270.62	141.03
Difference in Re-operative procedure risk (%)*	0	-7.9	155.29	7.9	126.78

Deep sternal infection cost (£)	1198.98	599.49	141.03	1798.47	141.03
Difference in deep sternal infection risk (%)*	0	-5.5	201.74	5.5	80.33
IABP cost (£)	2574.38	1287.19	63.82	3861.57	218.26
Difference in IABP risk (%)*	-6.0	-13.9	343.38	0	-13.43
MI cost (£)	2031.07	1015.54	90.26	3046.61	191.81
Difference in MI risk (%)*	-5.0	-11.3	268.58	0	45.92
CABG team composition	2 surgeons, 1 anaesthetist, 1 perfusionist, 2 cardiac nurses	1 surgeon, 1 anaesthetist, 1 perfusionist, 1 cardiac nurse	154.30	2 surgeons, 1 anaesthetist, 1 perfusionist, 2 cardiac nurses, 1 nurse anaesthetist, 2 physician assistants	134.45

*Risk with TTFM minus risk without TTFM.

3. Conclusions

After updating costs to reflect the most recent estimates the conclusion is unchanged from the previous cost update performed in 2016. The use of TTFM with MiraQ MQC02001 during CABG is predicted to lower procedure costs for CABG.