Table 1. *Costing groups for primary admissions of invasive GAS infection cases based on diagnosis and healthcare resource group codes, England 2008–10*

Costing group	Invasive GAS diagnosis code*	Invasive GAS hospital costing code†	Cases (%‡)
I	Yes	Yes	1250 (33.8)
II	No	Yes	387 (10.5)
III	Yes	No	585 (15.8)
IV	No	No	1178 (31.9)
All primary admissions	Yes/No	Yes/No	3400 (92.0)

GAS, group A streptococcal.

* One of 93 ICD-10 codes selected as indicative of invasive GAS infection.

† One of 48 healthcare resource group, version 4 codes associated with the 93 invasive GAS ICD-10 diagnosis codes.

‡ Of the total number of cases (n=3696).

Table 2. *Costs of primary hospital admissions for cases of invasive GAS infection, England 2008-10*

Costing group	*n*	Median duration of primary admission (IQR)	Hospital care (HRG4) costs (£)		Critical care costs				Combined annual HRG4 and critical care cost (million £)	Nosocomial GAS infections		Annual costs adjusted for nosocomial GAS infections (million £)
			Median (IQR)	Annual* (millions)	*n* (%)	Median (£, IQR)	Annual (million £)	Adjusted† annual (million £)		Cases (%)	Costs of admissions (million £)	
I	1250	9 (4 –17)	1707 (1324 – 3092)	1.20	65 (5.2)	5544 (1386 – 12470)	0.18	0.74	1.94	77 (6.2)	0.13	1.81
II	387	5 (3 –13)	1527 (842 – 2872)	0.34	12 (3.1)	4851 (2772 – 12820)	0.04	0.17	0.51	41 (10.6)	0.10	0.41
III	585	17 (8 –32)	3108 (1653 – 5599)	0.87	61 (10.4)	8316 (1386 – 29110)	0.35	1.38	2.26	53 (9.1)	0.24	2.01
IV	1161	9 (3 –20)	2141 (1132 – 4086)	1.39	46 (3.9)	4158 (1386 – 9702)	0.14	0.58	1.96	220 (18.9)	0.49	1.47
All primary admissions ‡	3383	9 (3 –20)	1980 (1292 – 3872)	3.80	184 (5.4)	5544 (1386 – 14210)	0.72	2.87	6.67	391 (11.6)	0.96	5.71

HRG4, healthcare resource group, version 4; GAS, group A streptococcal; IQR, interquartile range.

* Annual costs are an average for the three years of the study.

† Costs adjusted on basis of expected overall critical care frequency.

‡ From the full dataset 141 cases could not be linked to a HES record, 155 contained no primary admission within HES data and 17 could not be costed due to HRG4 codes not part of the NHS National Tariff.

Table 3. *Duration of primary admission and hospital care costs for cases of invasive GAS infection which died in hospital, England 2008–10*

Costing group	*n**	Cases who died in hospital (%)	Median duration of primary admission in days (IQR)				Median hospital care (HRG4) costs (IQR)			
			Non-fatal cases	Fatal cases	Comparison†		Non-fatal cases	Fatal cases	Comparison†	
					Z-score	*P* value			*Z*-score	*P* value
I	1173	219 (18.7)	10 (5–18)	2 (1–6)	13.04	<0.0001	1729 (1324–3128)	1707 (1324–1707)	5.06	<0.0001
II	346	19 (5.5)	5 (2–11)	0 (0–3)	5.02	<0.0001	1425 (842–2597)	1324 (751–1707)	1.55	0.0123
III	532	83 (15.6)	18 (9–33)	2 (1–14)	8.28	<0.0001	3359 (1836–5940)	1999 (1092–3906)	3.72	0.0002
IV	941	161 (17.1)	8 (3–16)	1 (1–6)	8.70	<0.0001	2051 (1076–3568)	1921 (1130–2900)	0.47	0.6400
All primary admissions	2992	482 (16.1)	10 (1–19)	2 (1–7)	17.60	<0.0001	1944 (1175–3666)	1707 (1324–2294)	4.42	<0.0001

HRG4, healthcare resource group, version 4; IQR, interquartile range.

* Costed cases with a linked primary hospital admission in HES (excluding nosocomial cases).

† Mann-Whitney U test.

Table 4. *Costs of secondary hospital admissions within 30 days of primary admission for cases of invasive GAS infection, England 2008-10*

Costing group	*n**	Secondary admissions per case (no. of cases)							Total number of secondary admissions	Hospital care (HRG4) costs (£)		Combined annual cost‡ (million £)	Invasive GAS infection admissions§	
		0	1	2	3	4	≥5	≥1		Median (IQR)	Annual† (millions)		n (%)	Annual cost (million £)
I	1173	957	173	25	7	3	8	216	315	1568 (935 – 2293)	0.21	0.22	125 (39.7)	0.10
II	346	286	43	10	3	3	1	60	92	1449 (742 – 2031)	0.06	0.06	15 (16.3)	0.01
III	532	415	94	15	3	4	1	117	159	1648 (1024 – 2886)	0.14	0.14	78 (49.1)	0.08
IV	941	741	151	29	3	3	14	200	377	1190 (630 – 1774)	0.22	0.22	66 (17.5)	0.05
All primary admissions	2992	2399	461	79	16	13	24	593	943	1449 (796 – 2061)	0.63	0.63	284 (30.1)	0.25

GAS, group A streptococcal; HRG4, healthcare resource group, version 4; IQR, interquartile range.

* Costed cases with a linked primary hospital admission in HES (excluding nosocomial cases).

† Annual costs are an average for the three years of the study.

‡ Includes costs for critical care.

§ Admissions defined by the recording of an invasive GAS infection ICD-10 diagnosis code.

Table 5. *Subgroup sensitivity analysis of hospital care costs for cases of invasive GAS infections, England 2008-10*

Estimate level	Primary hospital admission costing groups (*n**)	Percentage of total cases†	Total annual‡ costs of primary hospital admissions (million £)	Secondary hospital admissions included	Total costs of secondary hospital admissions (million £)	Combined costs of primary and secondary admissions (million £)	Median total costs (£) per costed case (IQR)
Lower	I-III (2051)	55.5	4.23	Invasive GAS diagnosis§	0.20	4.43	1984 (1324 – 4458)
Upper	I-IV (2992)	81.0	5.71	All	0.63	6.34	2212 (1324 – 4952)

GAS, group A streptococcal; IQR, interquartile range.

* Number of cases after removal of those that could not be costed and nosocomial cases.

† For the entire study (n=3696).

‡ Annual costs are an average for the three years of the study.

§ Includes only secondary hospital admissions with a diagnosis code for invasive GAS infection.

Table 6. *Distribution of cases and total annual hospital care costs by age group for invasive GAS infections, England 2008-10*

Age group	Number of cases (%)	Total annual costs (million £)	
		Lower estimate (%)	Upper estimate (%)
All ages	3383 (100.0)	4.43 (100.0)	6.34 (100.0)
0-15 years	539 (15.9)	0.53 (12.0)	0.72 (11.4)
16-64 years	1346 (39.8)	2.11 (47.6)	3.03 (47.8)
≥65 years	1498 (44.2)	1.80 (40.6)	2.58 (40.7)

Table 7. *Types of main operative procedures recorded for primary hospital admissions of cases of invasive GAS infection by age group and by number of main procedures, England 2008-10*

OPCS-4 study group*	OPCS-4 study sub-group	No. of primary admissions undergoing ≥1 main procedure (%†)				No. of primary admissions according to the number of main procedures recorded‡						Total no. of procedures
		All ages (*n*=2997)	0-15 years (*n*=511)	16-64 years (*n*=1207)	≥65 years (*n*=1279)	0	1	2	3	4	≥5	
Cardiovascular care	Cardiac interventions	15 (0.5)	1 (0.2)	8 (0.7)	6 (0.5)	2982	12	3				18
	Echocardiography	229 (7.6)	15 (2.9)	129 (10.7)	85 (6.6)	2768	182	35	6	6		294
	Intravenous and intra-arterial procedures	407 (13.6)	58 (11.4)	197 (16.3)	152 (11.9)	2590	273	101	18	6	9	612
Diagnostics	Biopsies	28 (0.9)	3 (0.6)	14 (1.2)	11 (0.9)	2969	27	1				29
	Diagnostic imaging and tests	882 (29.4)	116 (22.7)	410 (34.0)	356 (27.8)	2115	131	267	214	111	159	2807
Gastrointestinal care	Endoscopy or intubation of gastrointestinal tract	105 (3.5)	1 (0.2)	36 (3.0)	68 (5.3)	2892	76	26	3			137
Gynaecology and obstetric care	Female genital tract procedures	10 (0.3)	0 (0.0)	8 (0.7)	2 (0.2)	2987	8	2				12
	Pregnancy and delivery (excluding surgical delivery)	29 (1.0)	0 (0.0)	29 (2.4)	0 (0.0)	2968	21	7	1			38
Renal care	Catheterisation and endoscopic examination of bladder	40 (1.3)	1 (0.2)	9 (0.7)	30 (2.3)	2957	33	4	2	1		51
	Dialysis for renal failure	121 (4.0)	4 (0.8)	66 (5.5)	51 (4.0)	2876	86	16	6	4	9	230
Respiratory care	Endoscopy of respiratory tract	74 (2.5)	8 (1.6)	44 (3.6)	22 (1.7)	2923	57	13	2	2		97
	Invasive ventilations and associated procedures	109 (3.6)	0 (0.0)	65 (5.4)	44 (3.4)	2888	80	25	1	2	1	146
	Non-invasive ventilations and associated procedures	274 (9.1)	38 (7.4)	135 (11.2)	101 (7.9)	2723	215	48	7	3	1	352
	Pleural drainage and respiratory tests	128 (4.3)	22 (4.3)	86 (7.1)	20 (1.6)	2869	79	33	10	5	1	201
Surgery and associated procedures	Abdominal surgery	72 (2.4)	3 (0.6)	55 (4.6)	14 (1.1)	2925	49	15	7	1		104
	Amputations	55 (1.8)	1 (0.2)	27 (2.2)	27 (2.1)	2942	38	11	4	1	1	88
	Chest surgery including heart and lung	21 (0.7)	5 (1.0)	13 (1.1)	3 (0.2)	2976	13	5	1	1	1	35
	Female genital tract and pregnancy-related operations	36 (1.2)	1 (0.2)	34 (2.8)	1 (0.1)	2961	29	5	1	1		46
	Gastrointestinal tract surgery	41 (1.4)	5 (1.0)	21 (1.7)	15 (1.2)	2956	31	9	1			52
	Head and neck surgery	64 (2.1)	17 (3.3)	29 (2.4)	18 (1.4)	2933	35	11	6	10	2	125
	Skin surgery	191 (6.4)	11 (2.2)	115 (9.5)	65 (5.1)	2806	80	44	22	22	23	469
	Soft tissue and musculoskeletal surgery	339 (11.3)	55 (10.8)	164 (13.6)	120 (9.4)	2658	171	85	44	19	20	670
	Unclassified operative procedures	170 (5.7)	16 (3.1)	102 (8.5)	52 (4.1)	2827	130	34	3	2	1	221
Treatment and rehabilitation	High cost drugs	35 (1.2)	4 (0.8)	21 (1.7)	10 (0.8)	2962	26	8	1			46
	Injections, infusions and transfusions	47 (1.6)	11 (2.2)	20 (1.7)	16 (1.3)	2950	40	5	1	1		62
	Other treatments (including anaesthetic drugs)	54 (1.8)	9 (0.3)	30 (1.0)	15 (0.5)	2943	39	14	1			70
	Rehabilitation	35 (1.2)	0 (0.0)	6 (0.5)	29 (2.3)	2962	31	3	1			40
	Resuscitation	30 (1.0)	1 (0.2)	10 (0.8)	19 (1.5)	2967	28	2				32
Any costing group	Any study sub-group	1688 (56.3)	231 (45.2)	794 (65.8)	663 (51.8)	1309	370	333	243	187	555	7084

GAS, group A streptococcal; OPCS-4, Office of Population Censuses and Surveys classification of interventions and procedures, version 4.

* Grouping according to Supplementary Table 3.

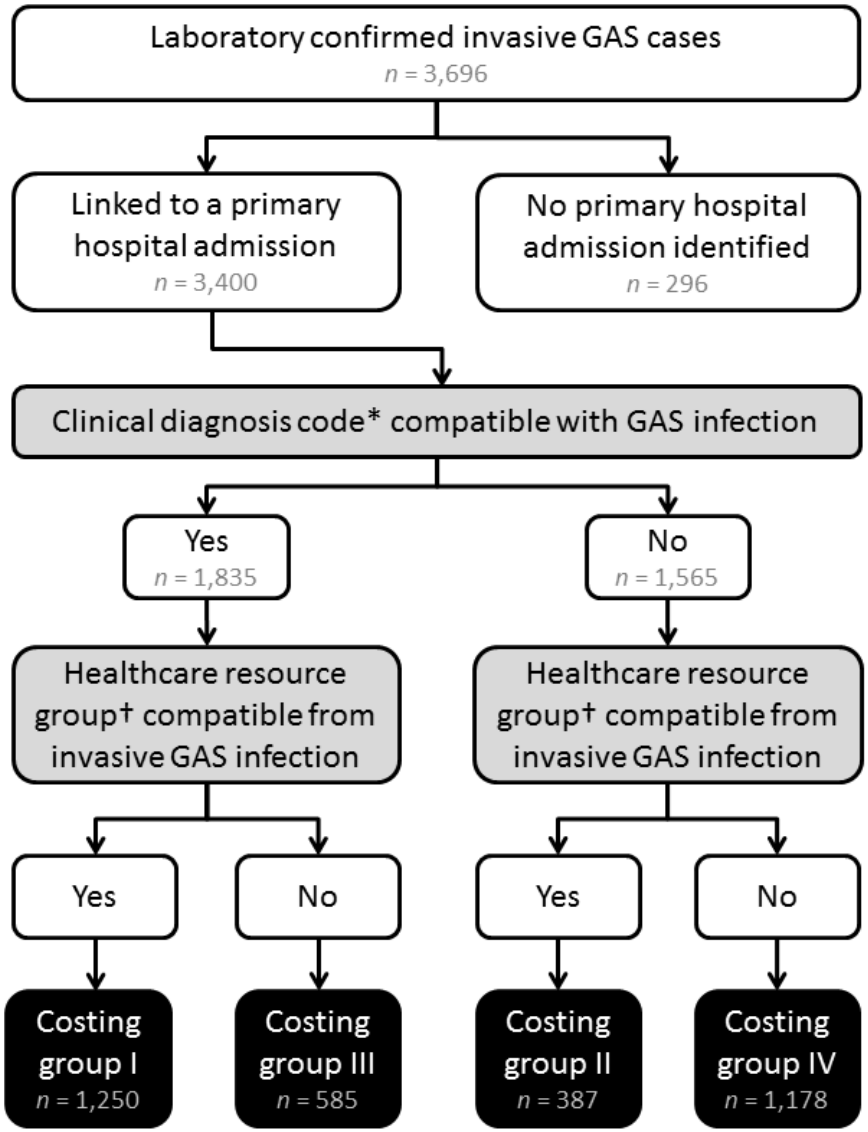
† Percentage of primary admissions within each age group not defined as nosocomial infections.

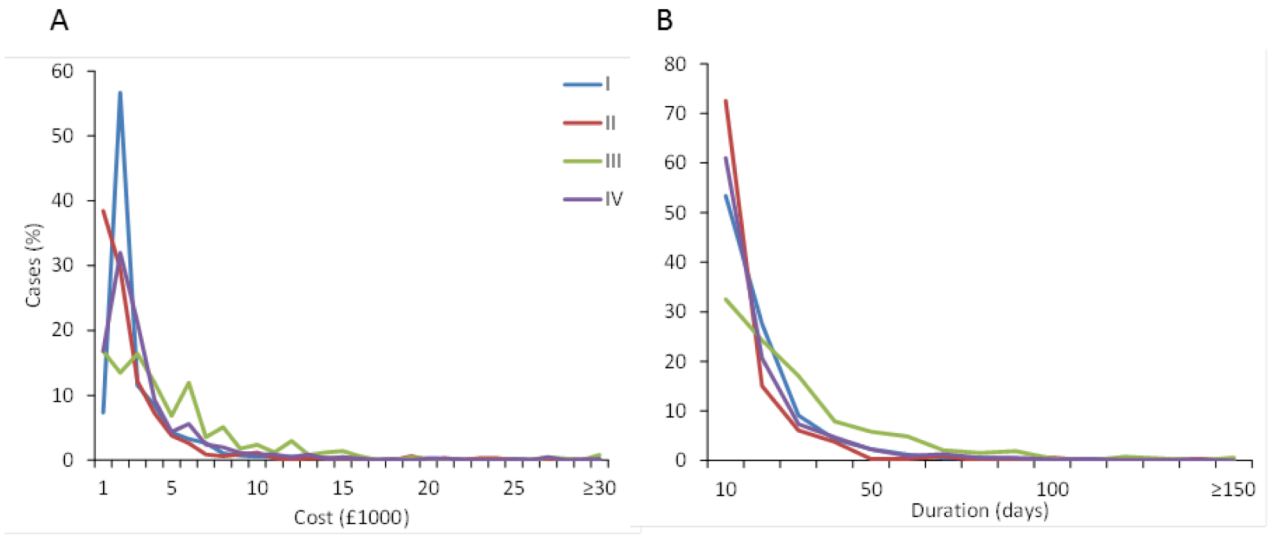
‡ Zeroes have been omitted for ease of presentation.

FIGURE LEGEND

Fig. 1. Schematic outlining the attribution of cases to costing groups of invasive GAS cases. *ICD-10 primary diagnosis code. †Healthcare resource group code, version 4.

Fig. 2. Distribution of (A) primary admission costs (HRG4 resource groups) and (B) duration of primary admission for cases in costing groups (I – IV). Nosocomial cases have been excluded.


Laboratory confirmed invasive GAS cases
n = 3,696
Linked to a primary hospital admission
n = 3,400
No primary hospital admission identified
n = 296
Clinical diagnosis code* compatible with GAS infection
Yes
n = 1,835
No
n = 1,565
Healthcare resource group† compatible from invasive GAS infection
Healthcare resource group† compatible from invasive GAS infection
Yes
No
Yes
No
Costing group I
n = 1,250
Costing group III
n = 585
Costing group II
n = 387
Costing group IV
n = 1,178


A
60
50
40
30
20
10
0
Cases (%)
I
II
III
IV
1
5
10
15
20
25
≥30
Cost (£1000)
B
80
70
60
50
40
30
20
10
0
10
50
100
≥150
Duration (days)