The Strategy Unit.

Modelling Patients Flows under Potential Configurations of Emergency Centres with Specialised Services in the West Midlands

NHS
Midlands and Lancashire
Commissioning Support Unit

Background

Onsite, 24/7 access to complex vascular surgery, hyper acute stroke services and primary percutaneous coronary interventions are expected to be a pre-requisite for a hospital to be designated as an emergency centre with specialised services.

This paper sets out the patient access and patient flow implications of reconfiguring and centralising these three services within the West Midlands.

This analysis has been produced with time constraints and as a result uses appropriate simplifications in order to provide headline descriptions of the current and possible future configurations, accepting that more detailed analysis would be required if local policy makers believed the proposed configurations warranted further consideration.

The table overleaf shows the current supply arrangements for each of the three services in the West Midlands. Supply of these services in some STP footprints is undergoing change as a result of recent reconfiguration debates.

Following discussions with Dr Kiran Patel, Medical Director, NHS England (West Midlands), the travel times and patient flows have been estimated under two possible future configurations.

Configuration 1 - 2 centres in Birmingham and Solihull, one centre in each of the other STP footprints

Configuration 2 - one centre in each STP footprint

The selection of sites was agreed in discussion with Dr Kiran Patel.

Current and Possible Future Configurations

STP	Hospital	Current Arrangements			Possible Future Arrangement (VS + PPCI + HAS)
		Complex Vascular Surgery	PPCI	Hyper Acute Stroke	
The Black Country & West Birmingham	Russells Hall Dudley	●	●	●	
	New Cross Wolverhampton	○	●	●	●
	Sandwell		○	●	
	Manor Walsall			○	
	City Birmingham				
Birmingham and Solihull	QE Birmingham	●	●	●	●
	Heartlands Birmingham	●	●	●	●[1]
	Good Hope Birmingham		○	○	
	Solihull				
Coventry and Warwickshire	University Coventry	●	●	●	●
	Warwick			○	
	George Eliot Nuneaton			○	
Herefordshire and Worcestershire	Worcestershire Royal	●	●	●	●
	Hereford County			○	
	Alexandra Redditch				
Shropshire and Telford and Wrekin	Princess Royal Telford			●	
	Royal Shrewsbury	○			●
Staffordshire	Royal Stoke	●	●	●	●
	Queens Burton			○	
	County Stafford				

● *major supplier (>5% of regional activity in 2015/16)*

○ *minor supplier (>2% of regional activity in 2015/16)*

1 *configuration 1 only*

Key findings

NOTE-This analysis is illustrative only and is based on a set of defined modelling assumptions that were set in part to facilitate a quick, high level output to support discussions about the need for further, more detailed work.

Some STPs have already achieved substantial centralisation of activity (Herefordshire & Worcestershire, Coventry & Warwickshire and Staffordshire). Under the options considered in this paper, the biggest additional concentration effect would be felt in the Black Country and in Birmingham & Solihull (configuration 2) with significant consequences for individual provider workload and for patient flows (including 'outflows'). RWHT, for example, would double the total numbers of spells across the three services.

For the specialities/services considered, no STP is currently 'self-sufficient', though some experience significantly greater 'outflows' than others. Staffordshire is the largest exporter , driven by travel realties for parts of its geography [see slides 11-14 and the import/export summary on slide 15]. Under possible future reconfiguration, this would still be the case and for some STPs the extent of 'outflows' would increase if the predominant driver is to minimise travel time [see slides 23/4 and 40/41 show this for configurations 1 and 2]. For example, under configuration 2, c 20-30% of activity would shift out of Birmingham & Solihull STP, predominantly to UHCW , due to travel times for populations on the east of the STP if Heartlands Hospital is no longer an option. Any policy of STP self-sufficiency would be difficult to justify from a patient point of view given access realities .

Under any option, it is clear that Shropshire is a low outlier in terms of volumes for some activity (vascular; PPCI) . This report makes no attempt to consider viability. It might be noted, however, that for PPCI, Shropshire (currently without in-county provision) experiences what appears to be comparatively low access rates. The modelling in this report takes no account of whether changes to patterns of provision might change levels of demand.

Key findings (2)

Even on the current configuration, long travel times for 'time sensitive conditions' (i.e.95th percentile) are only a significant issue/concern in Herefordshire & Worcestershire and Shropshire. The concentration option for hyper acute stroke in configurations 1 & 2 would have a very significant worsening effect on access times for Herefordshire (38 mins to 61 minutes). Slides 32, 33, 48, 49 show the impact of the two options on average times and on distribution of times.

Both configurations 1 & 2 would result in some providers undertaking very large volumes of activity. The question of when diseconomies of scale set in would be an important one to examine in considering such options.

This report doesn't attempt to model the associated volume impacts of redistribution of 'mimic' activity. Appendix 1 shows the significance of this factor and any consideration of reconfiguration options would need to include the capacity implications.

The significant volume of out-of-hours activity in all 3 services [see slide 16] reinforces the need for clinically viable 24hr services. That being said, the low volume of out of hours PPCI (c. 17 per week) questions for Birmingham & Solihull the case for running multiple out-of-hours rotas.

The volumes of non-emergency transfers and other cerebro-vascular emergency admissions are significant.

Possible Further Work

If there is an appetite amongst STP leaders to pursue this analysis further then subsequent analytical commissions could include;

- the consideration of alternative configurations for activity of this type
- the inclusion of additional services requiring that might only be undertaken at an emergency centre with specialised services
- more complex criteria rules to distribute activity between hospitals (e.g. boundary protection rules)
- the capacity (beds, theatres/labs, workforce) required at each hospital to
- the potential value of rotating service locations out of hours
- the impact on ambulance services
- the impact of post-hyper-acute repatriation arrangements
- the impact of emergency centres with specialised services outside the West Midlands
- expected changes in levels of demand due to changes in demography and age-specific health status
- need, demand and supply of thrombectomies.

In addition, analysis might consider the distribution of activity for other tiers (e.g. emergency centres without specialised services, A&E centres, community services) under various proposed configurations.

Data sources, definitions, methods and assumptions

Assumptions

This analysis will assumes that;

- Patients will be conveyed to the nearest of the hospitals in the configuration. Proximity will be determined using local road networks and average travel times for the relevant time of day.
- All patients will receive a pre-hospital diagnosis
- All West Midlands patients will be seen by a hospital in the West Midlands
- Patients registered with GP practices outside of the West Midlands will not be considered at this stage
- Patient's admission status and length of stay will not be altered by any service reconfiguration
- No changes in service demand

Analysis is limited to adult (18+ years) inpatient activity.

The use of shortest drivetime as the sole means of determining the likely destination hospital of patient in some future configuration is simplistic, but not unreasonable for emergency activity.

A more comprehensive analysis including inflows of patients registered outside the West Midlands and outflows of West Midlands registered patient to sites outside the West Midlands is likely to decrease expected supply in eastern Staffordshire and increase expected supply in Shropshire.

This analysis relates to activity where a patient is admitted for stroke, PPCI or vascular surgery. It is known however, that many patients are conveyed to emergency centres with symptoms that mimic a stroke or AMI. Any reconfiguration of these services will also therefore result in the redistribution of stroke and AMI mimics patients. Appendix 1 provides a brief summary of the evidence on the scale of stroke and AMI mimics.

Defining Vascular Surgery, PPCI and Hyper Acute Stroke Activity

Activity data for this analysis is sources from the Secondary Uses Service Admitted patient Care and A&E attendances tables for 2015/16.

Hyper acute stroke admissions are defined as those patients aged 18+, admitted in an emergency (admimeth = 2*) with an ICD10 primary diagnosis of I61, I63 or I64 in any episode within the spell.

PPCI admissions are defined as those patients aged 18+ admitted in an emergency (admimeth = 2*) with an OPCS4 procedure code of K49, K50, K75 in any position and in any episode in the spell.

Vascular surgery admissions are defined as those patients aged 18+ admitted in any circumstances (elective and non-elective) with an OPCS4 procedure code of

L183, L184, L185,L191, L192, L193, L194, L195, L201, L202, L203, L204, L205, L211, L212, L213, L214, L215, L221, L223, L224, L265, L266, L271, L272, L273, L274, L281, L282, L283, L284, L293, L305, L313, L314, L318, L319, L411, L412, L413, L414, L415, L416, L418, L419, L436, L451, L452, L453, L454, L458, L459, L461, L462, L463, L464, L468, L474, L478, L479, L651, L664, L747, L751, L981, L982 or L983 in any position and in any episode in the spell.

Data on elective PCI admissions (admimeth = 1*), emergency admissions for TIA (ICD10 G454, G458, G459) and other cerebrovascular diseases (ICD10 I60, I62, I65, I66, I67, I68. I69) and for non-emergency transfers (admimeth 81) for PPCI and hyper acute stroke are provided for context.

Estimating travel times and destinations

Travel times in this analysis have been calculated based on the patient's home address. Although the decision to attend hospital services or the beginning of the ambulance journey is not always at home, unfortunately there is no other geographical identifier available in routine datasets.

Drive times have been calculated using the TRACC™ software, the Integrated Transport Network (ITN) road vectors and average off-peak travel speeds for each road link derived from GPS data by INRIX.

The baseline travel time was calculated as the journey from home postcode to the actual site of episode start for each patient. A small number of journeys were incalculable as either the home postcode or the destination postcode were outside of our data envelope (West Midlands with 10k buffer).

For estimating journeys for both configuration 1 and 2, the patient's home postcode was used as the journey origin and the shortest travel time (as opposed to shortest distance) calculated to each of the 7 or 6 destination sites in the configuration.

The nearest available site was selected as the minimum journey time and thus allocated to each patient individually.

Numbers were aggregated to sites, cohorts and STP for reporting purposes.

Current supply levels and travel times

Summary spells, bed days and travel times by STP of Patient

		STP of Patient					
		Black C & W. Birmingham	Birmingham & Solihull	Coventry & Warwickshire	Hereford & Worcestershire	Shropshire & Telford	Staffordshire
Registered population '000s *		1,424	1,253	950	774	483	1,134
Vascular Surgery	Spells	180	170	150	120	70	220
	Bed Days	1800	1200	1400	1500	700	2200
	Average travel Time (m)	18.6	13.7	18.2	37.2	38.8	23.5
	95th percentile travel time	30.9	25.1	40.6	86.3	78.1	44.3
PPCI	Spells	1120	1390	640	560	180	870
	Bed Days	5560	8990	2730	2470	740	4590
	Average travel Time (m)	14.8	11.2	18.6	30.7	53.5	21.4
	95th percentile travel time	29.9	22.9	35.7	61.7	78.9	44.8
Hyper Acute Stroke	Spells	1980	1730	1320	1400	1070	1670
	Bed Days	34930	24720	30470	21430	14860	22190
	Average travel Time (m)	11.5	12.0	15.5	21.7	23.2	17.4
	95th percentile travel time	19.5	22.4	29.8	37.9	48.2	30.9

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

** All ages – October 2015*

Vascular Surgery
2015/16 spells by Provider and STP

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	Russells Hall, Dudley	**100**	**90**					10
	New Cross, Wolverhampton	**30**	**20**					
Birmingham and Solihull	QE, Birmingham	**180**	60	**80**		20		10
	Heartlands, Birmingham	**140**	20	**70**		20	10	30
	Good Hope, Birmingham	**10**		**10**				10
Coventry & Warwickshire	UHCW, Coventry	**160**		10	**140**			
Hereford & Worcestershire	Worcestershire Royal	**80**				**80**		
Shropshire & Telford	Royal Shrewsbury	**40**					**40**	
Staffordshire	Royal Stoke	**180**					20	**160**
Total		**910**	**180**	**170**	**150**	**120**	**70**	**220**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

Primary Percutaneous Coronary Intervention

2015/16 spells by Provider and STP

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**740**	**510**				70	150
	City, Birmingham	**420**	**340**	70				
	Sandwell	**160**	**150**	10				
Birmingham and Solihull	Heartlands, Birmingham	**770**	40	**650**	20			50
	QE, Birmingham	**520**	50	**420**		40		
	Good Hope, Birmingham	**230**	20	**130**	10			70
	Solihull	**100**		**90**				
Coventry & Warwickshire	University, Coventry	**600**		10	**580**			10
Hereford & Worcestershire	Worcestershire Royal	**500**		10	10	**460**	20	
	Alexandra, Redditch	**50**				**50**		
Shropshire & Telford		**0**					**0**	
Staffordshire	Royal Stoke	**680**			10		90	**580**
Total		**4770**	**1120**	**1390**	**640**	**560**	**180**	**870**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

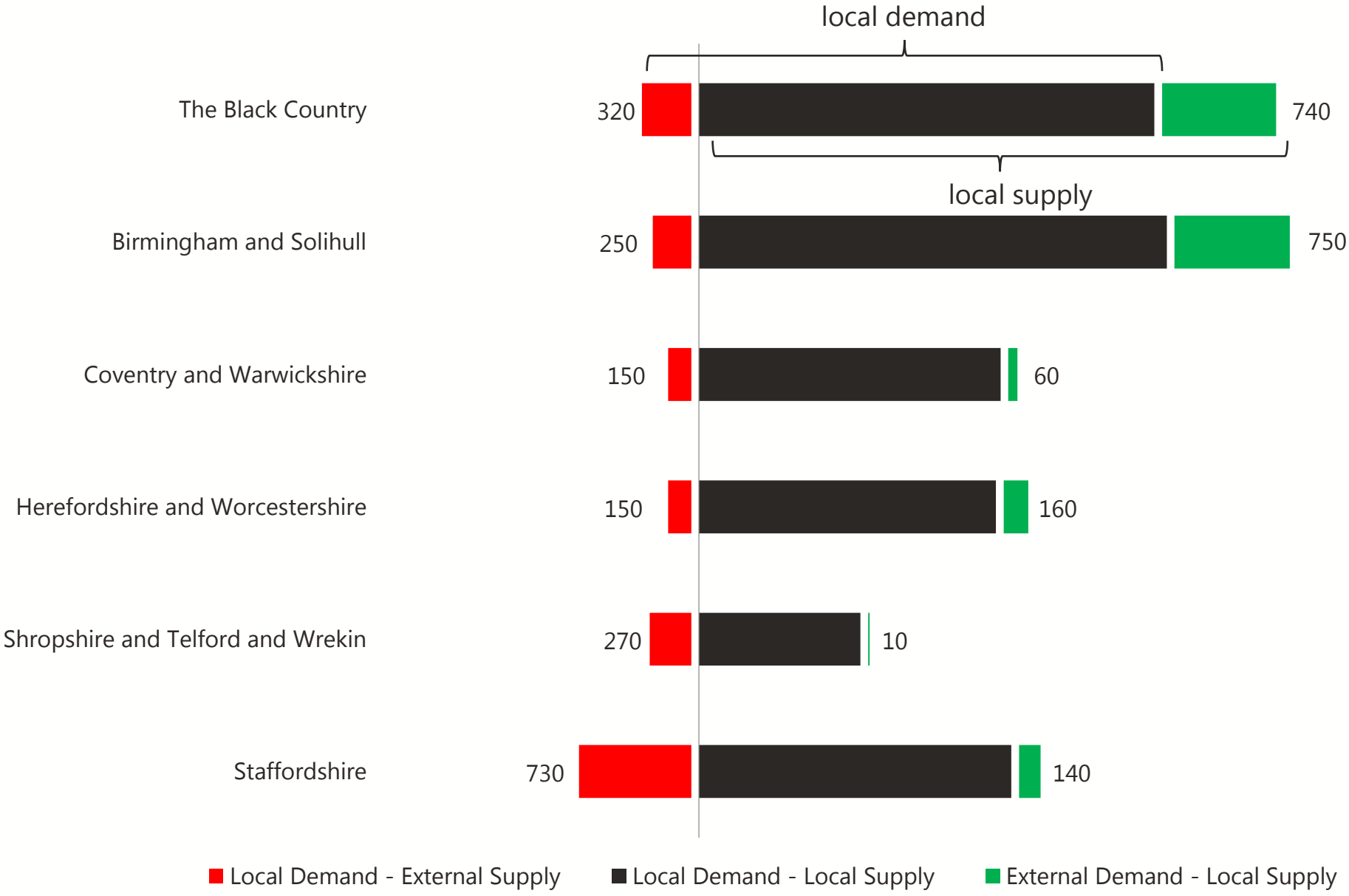
Hyper Acute Stroke

2015/16 spells by Provider and STP

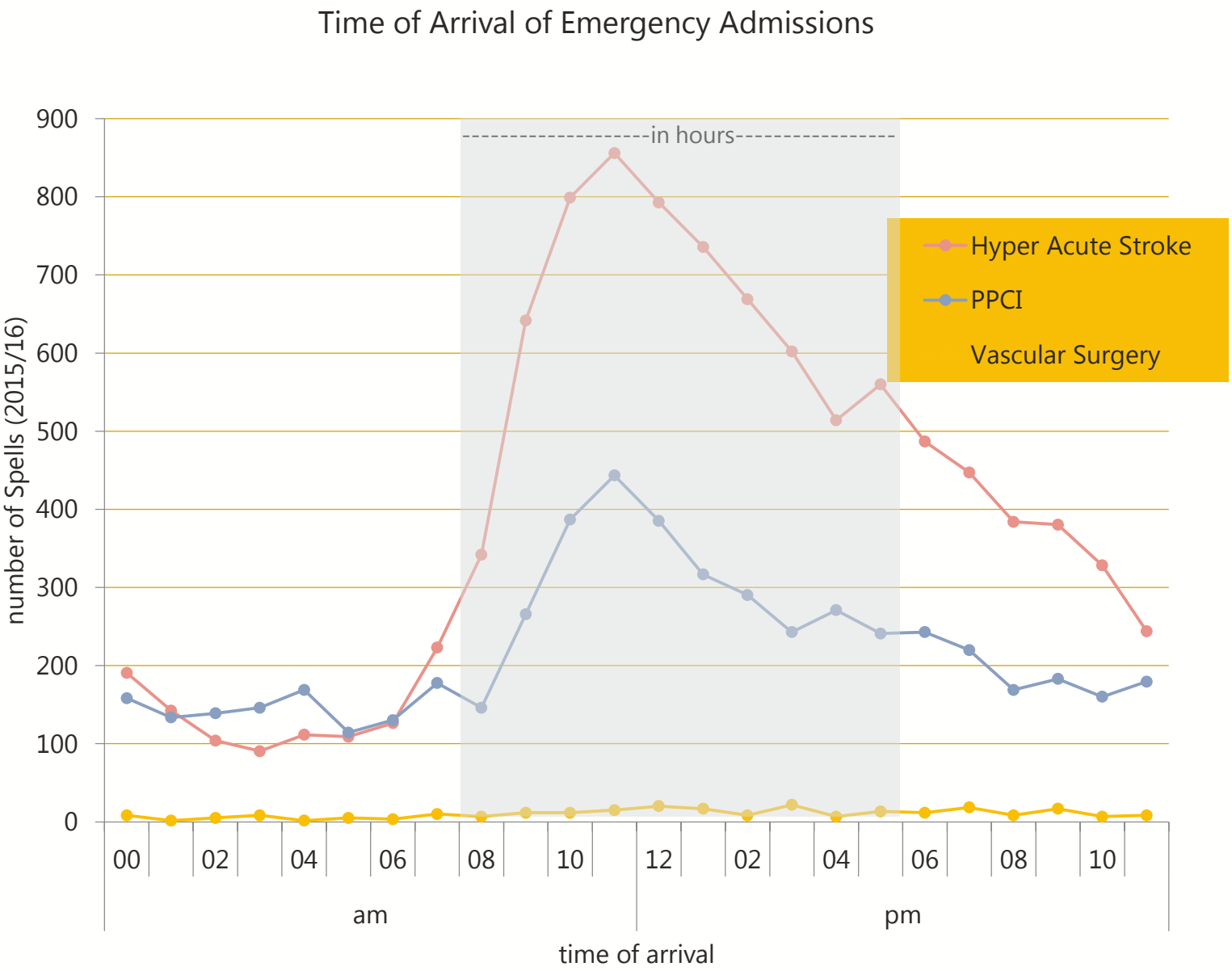
			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	Russells Hall, Dudley	**620**	**560**			20		40
	New Cross, Wolverhampton	**610**	**520**	90				
	Sandwell	**610**	**410**				10	190
	Manor, Walsall	**380**	**320**	10				50
	City, Birmingham	**50**	**40**	20				
	Other	**10**						
Birmingham and Solihull	Heartlands, Birmingham	**840**	20	**760**	30			40
	QE, Birmingham	**670**	70	**560**		40		
	Good Hope, Birmingham	**200**	10	**150**	10			50
	Solihull	**110**		**110**				
	Other	**10**		**10**				
Coventry & Warwickshire	University, Coventry	**750**		10	**730**			10
	Warwick	**300**		10	**290**			
	George Eliot, Nuneaton	**200**			**200**			
	Other	**20**			**20**			
Hereford & Worcestershire	Worcestershire Royal	**920**	20	10	40	**840**	10	
	Hereford Country	**450**				**420**	30	
	Alexandra, Redditch	**50**			10	**40**		
	Other	**40**				**40**		
Shropshire & Telford	Princess Royal, Telford	**930**					**920**	10
	Royal Shrewsbury	**80**					**80**	
	Other	**10**					**10**	
Staffordshire	Royal Stoke	**950**					20	**930**
	Queens, Burton	**300**						**290**
	Country, Stafford	**60**						**60**
	Other	**10**						**10**
Total		**9170**	**1980**	**1730**	**1320**	**1400**	**1070**	**1670**

Numbers rounded to the nearest 10 spells. Numbers may not sum to totals due to rounding.

Importing and Exporting Activity



Arrival Time Distribution



34% of hyper acute stroke cases, 44% of PPCI cases and 46% of emergency vascular surgery cases arrive out of hours (before 8am or after 6pm).

Arrival time of emergency admissions derived from linked A&E attendance record.

Note that linked A&E attendance records could not be found for all cases. This may be because some unit have A&E bypass arrangements for cases of this type.

Supply levels and travel times under proposed configuration 1

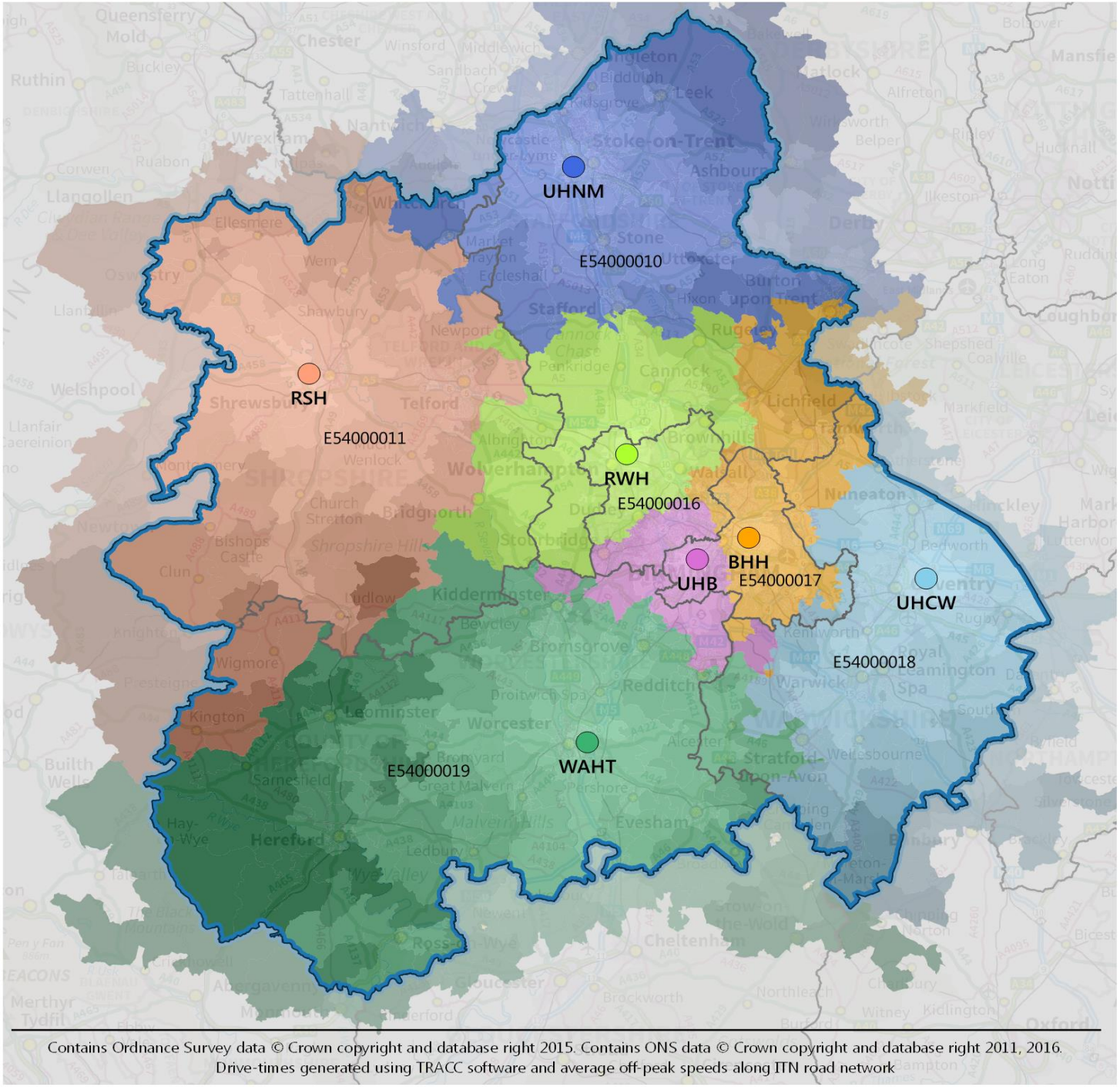
Configuration 1

Vascular Surgery, PPCI and Hyper Acute Stroke Services delivered at 7 sites;

- New Cross, Wolverhampton
- QE, Birmingham
- Heartlands, Birmingham
- UHCW, Coventry
- Worcestershire Royal
- Royal Shrewsbury
- Royal Stoke

The preferred option for location of a single emergency care centre in Shropshire/Telford is still to be consulted upon and decided. For this analysis, Shrewsbury has been used as it is understood that the recommendation from the Evaluation Panel is for that option though this is still under consideration locally.

Map – nearest provider by Lower Super Output Areas



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Drive-times generated using TRACC software and average off-peak speeds along ITN road network

West Midlands Specialist Acute Services Configuration 1

NHS

Code:	Site description:
BHH	Heartlands Hospital
RSH	Royal Shrewsbury Hospital
RWH	Royal Wolverhampton Hospital
UHB	QE, Birmingham
UHCW	University Hospital, Coventry
UHNM	Royal Stoke University Hospital
WAHT	Worcestershire Royal Hospital

<10 10-19 20-29 30-39 40-49 50-59 60+

Nearest site drive times by Lower Super Output Area (minutes)

Code:	STP description:
E54000010	STAFFORDSHIRE
E54000011	SHROPSHIRE AND TELFORD & WREKIN
E54000016	THE BLACK COUNTRY
E54000017	BIRMINGHAM AND SOLIHULL
E54000018	COVENTRY AND WARWICKSHIRE
E54000019	HEREFORDSHIRE AND WORCESTERSHIRE

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Vascular Surgery

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**140**	**100**				10	30
Birmingham and Solihull	QE, Birmingham	**140**	70	**60**		10		
	Heartlands, Birmingham	**180**	20	**110**	10			50
Coventry & Warwickshire	UHCW, Coventry	**140**			**140**			
Hereford & Worcestershire	Worcestershire Royal	**120**			10	**110**		
Shropshire & Telford	Royal Shrewsbury	**60**					**50**	
Staffordshire	Royal Stoke	**140**						**140**
Total		**910**	**180**	**170**	**150**	**120**	**70**	**220**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

Primary Percutaneous Coronary Intervention

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**770**	**560**				20	190
Birmingham and Solihull	QE, Birmingham	**860**	370	**400**		80		
	Heartlands, Birmingham	**1340**	190	**980**	40			130
Coventry & Warwickshire	UHCW, Coventry	**590**		10	**590**			
Hereford & Worcestershire	Worcestershire Royal	**500**			20	**470**	10	
Shropshire & Telford	Royal Shrewsbury	**150**				10	**140**	
Staffordshire	Royal Stoke	**570**					10	**560**
Total		**4770**	**1120**	**1390**	**640**	**560**	**180**	**870**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

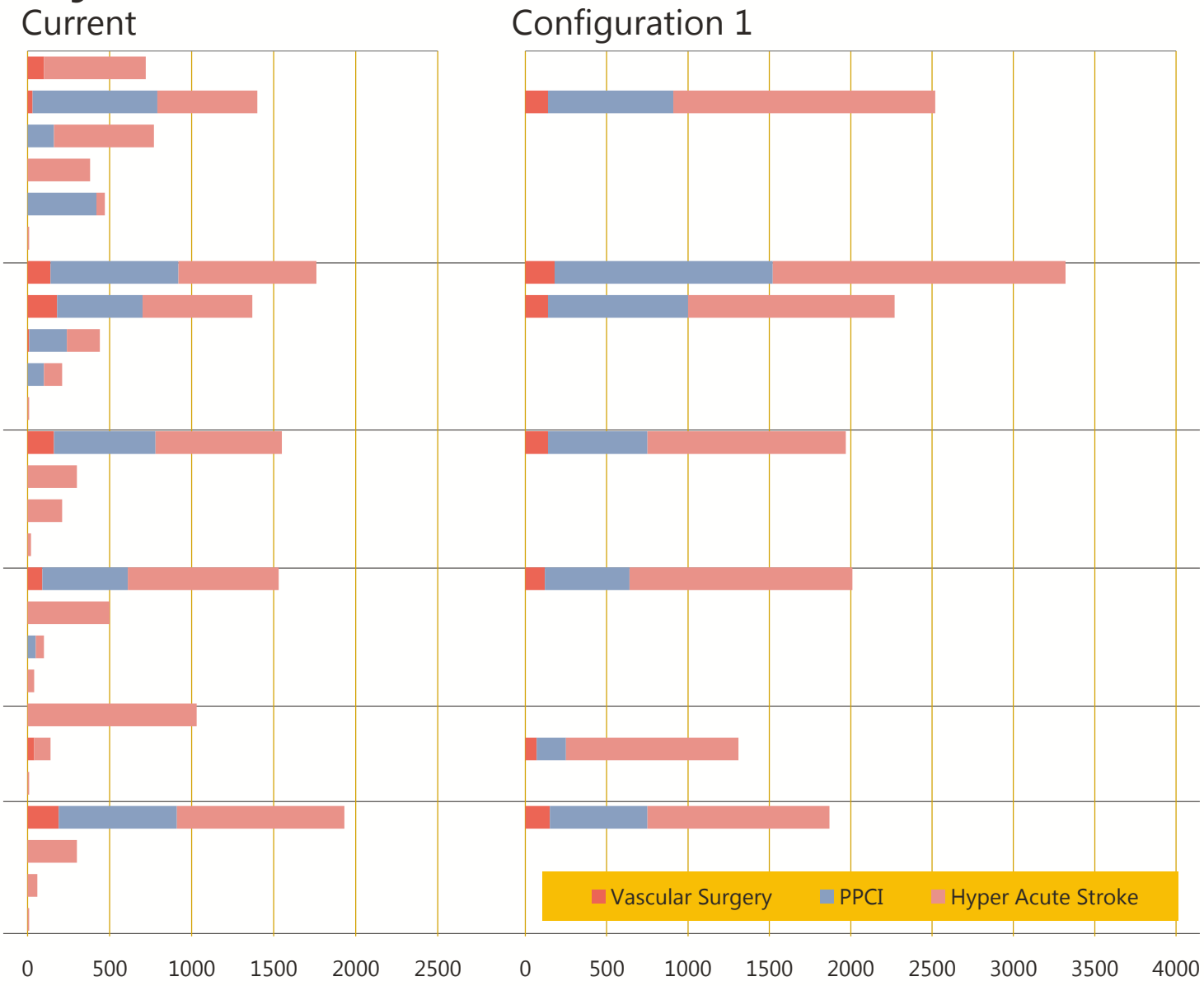
Hyper Acute Stroke

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**1610**	**1120**				110	380
Birmingham and Solihull	QE, Birmingham	**1270**	620	**540**	10	100		
	Heartlands, Birmingham	**1790**	240	**1160**	90			300
Coventry & Warwickshire	UHCW, Coventry	**1190**		20	**1170**			
Hereford & Worcestershire	Worcestershire Royal	**1350**		10	60	**1270**	20	
Shropshire & Telford	Royal Shrewsbury	**900**				20	**880**	
Staffordshire	Royal Stoke	**1050**					60	**990**
Total		**9170**	**1980**	**1730**	**1320**	**1400**	**1070**	**1670**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

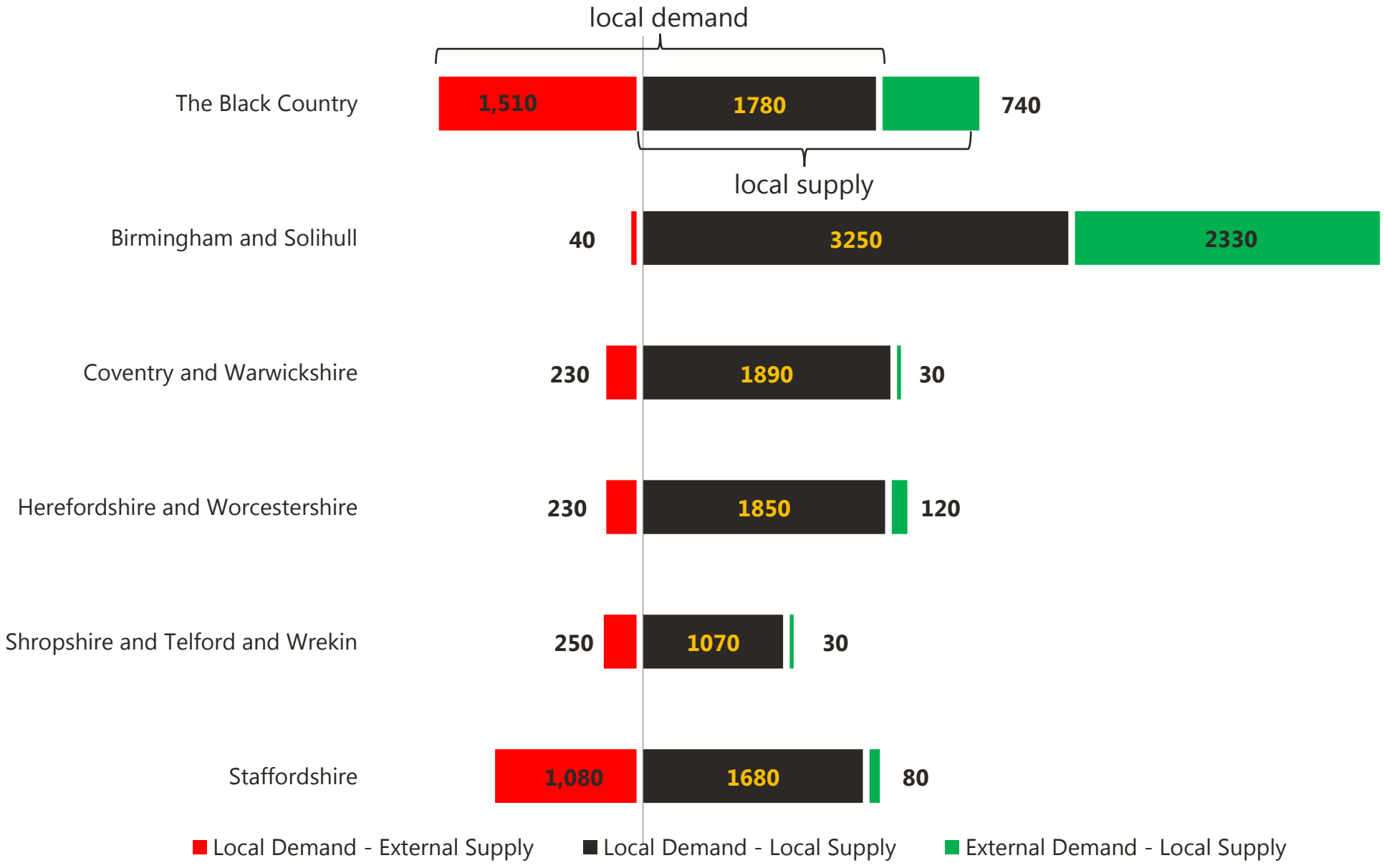
Redistribution of Spells by Provider

Black Country & West Birmingham	Russells Hall, Dudley
	New Cross, Wolverhampton
	Sandwell
	Manor, Walsall
	City, Birmingham
	Other
Birmingham and Solihull	Heartlands, Birmingham
	QE, Birmingham
	Good Hope, Birmingham
	Solihull
	Other
Coventry & Warwickshire	University, Coventry
	Warwick
	George Eliot, Nuneaton
	Other
Hereford & Worcestershire	Worcestershire Royal
	Hereford Country
	Alexandra, Redditch
	Other
Shropshire & Telford	Princess Royal, Telford
	Royal Shrewsbury
	Other
Staffordshire	Royal Stoke
	Queens, Burton
	Country, Stafford
	Other



Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

Importing and Exporting Activity



The Black Country & West Birmingham – Activity taking place in the STP

Current Configuration	New Cross, Wolverhampton Spells	Russells Hall, Dudley Spells	Sandwell Spells	Manor, Walsall Spells	City, Birmingham Spells
Vascular Surgery	30	100			
PPCI	760		160		420
Hyper Acute Stroke	610	620	610	380	50
Other relevant activity					
non-emergency transfers (PPCI, HAS)	140	10	10	10	10
other emergency cerebro-vascular (inc. TIA)	200	260	200	150	30
Elective PCI	390		50		290

Proposed Configuration **New Cross, Wolverhampton**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	140	3	(0 - 6)	0.3	1500
PPCI	770	15	(7 - 22)	7	3800
Hyper Acute Stroke	1610	31	(20 - 42)	10	25500

Birmingham and Solihull – Activity taking place in the STP

Current Configuration	QE Birmingham Spells	Heartlands Birmingham Spells	Good Hope Birmingham Spells	Solihull Spells
Vascular Surgery	180	140	10	
PPCI	520	780	230	100
Hyper Acute Stroke	670	840	200	110
Other relevant activity				
non-emergency transfers (PPCI, HAS)	60		10	
other emergency cerebro-vascular (inc. TIA)	320	380	140	60
Elective PCI	260	540	10	20

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Birmingham and Solihull – Activity taking place in the STP

Proposed Configuration **QE Birmingham**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	140	3	(0 - 6)	0.2	1200
PPCI	860	16	(8 - 24)	7	4600
Hyper Acute Stroke	1270	24	(15 - 34)	8	22000

Proposed Configuration **Heartlands Birmingham**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	180	4	(0 - 7)	0.4	1400
PPCI	1340	26	(16 - 36)	11	8900
Hyper Acute Stroke	1790	34	(23 - 46)	13	27400

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Coventry and Warwickshire – Activity taking place in the STP

Current Configuration	University Coventry	Warwick	George Eliot Nuneaton
Vascular Surgery	160		
PPCI	620		
Hyper Acute Stroke	770	300	210
Other relevant activity			
non-emergency transfers (PPCI, HAS)	160	20	10
other emergency cerebro-vascular (inc. TIA)	470	120	90
Elective PCI	190		

Proposed Configuration **University, Coventry**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	140	3	(0 - 6)	0.3	1200
PPCI	590	11	(5 - 18)	5	2500
Hyper Acute Stroke	1190	23	(13 - 32)	8	28900

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Hereford & Worcestershire – Activity taking place in the STP

Current Configuration	Worcestershire Royal	Hereford County	Alexandra Redditch
Vascular Surgery	90		
PPCI	520		50
Hyper Acute Stroke	920	500	50
Other relevant activity			
non-emergency transfers (PPCI, HAS)	140		
other emergency cerebro-vascular (inc. TIA)	290	170	30
Elective PCI	200		

Proposed Configuration **Worcestershire Royal**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	120	2	(0 - 5)	0.2	1500
PPCI	500	10	(4 - 16)	5	2100
Hyper Acute Stroke	1350	26	(16 - 36)	9	20600

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Shropshire and Telford – Activity taking place in the STP

Current Configuration	Royal Shrewsbury	Princess Royal Telford
Vascular Surgery	40	
PPCI		
Hyper Acute Stroke	100	1030
Other relevant activity		
non-emergency transfers (PPCI, HAS)		
other emergency cerebro-vascular (inc. TIA)	80	370
Elective PCI		

Proposed Configuration **Royal Shrewsbury**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	60	1	(0 - 3)	0.1	500
PPCI	150	3	(0 - 6)	1	600
Hyper Acute Stroke	900	17	(9 - 25)	7	12900

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Staffordshire – Activity taking place in the STP

Current Configuration	Royal Stoke	Queens Burton	County Stafford
Vascular Surgery	190		
PPCI	720		
Hyper Acute Stroke	1020	300	60
Other relevant activity			
non-emergency transfers (PPCI, HAS)	470		80
other emergency cerebro-vascular (inc. TIA)	390	180	40
Elective PCI	500		

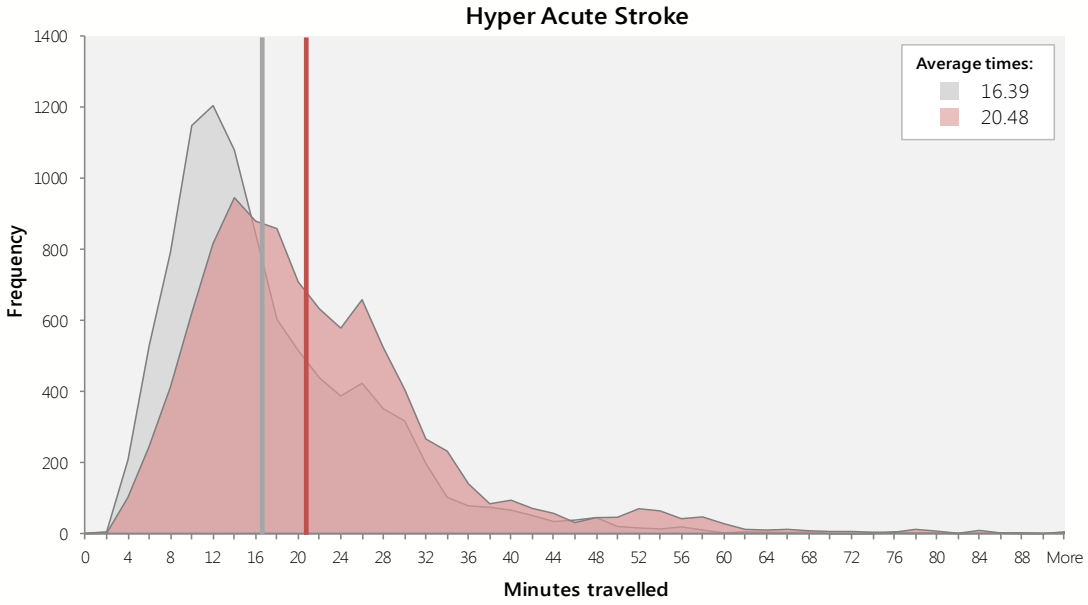
Proposed Configuration **Royal Stoke**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	140	3	(0 - 6)	0.4	1500
PPCI	570	11	(4 - 17)	5	2500
Hyper Acute Stroke	1050	20	(11 - 29)	7	11400

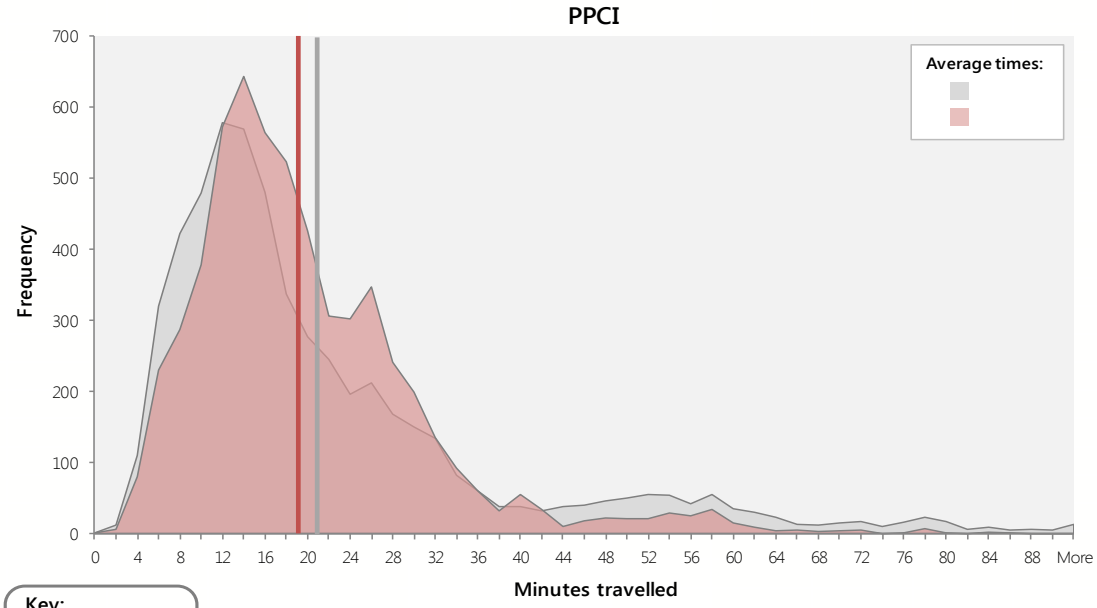
Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

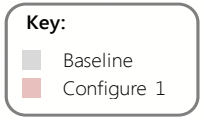
Travel Times by STP of patient

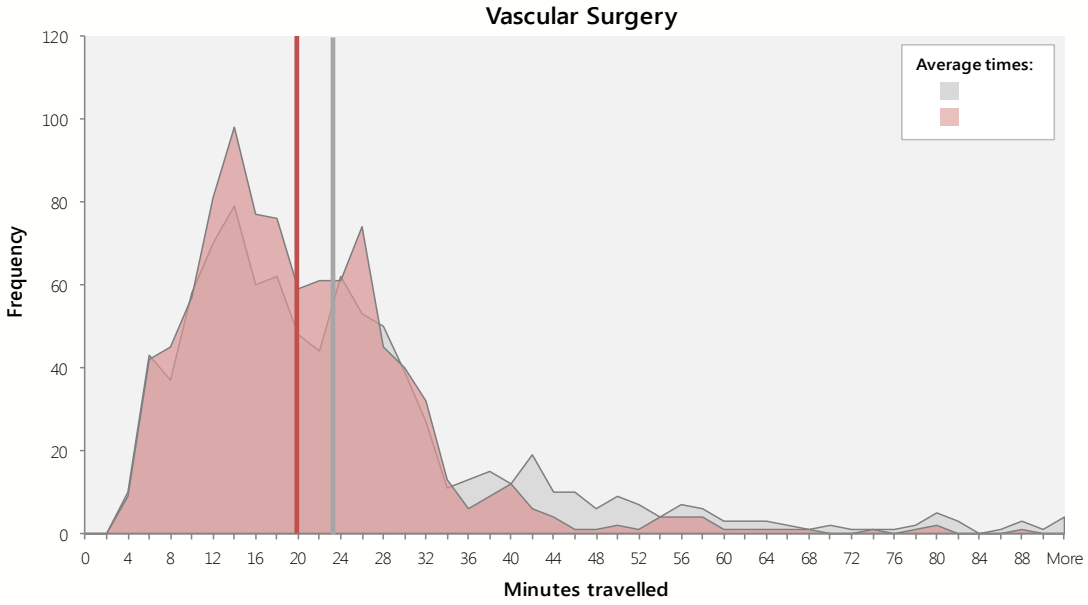
		Black C & W. Birmingham		Birmingham and Solihull		Coventry & Warwickshire		Hereford & Worcestershire		Shropshire & Telford		Staffordshire	
		Curr.	CF1	Curr.	CF1	Curr.	CF1	Curr.	CF1	Curr.	CF1	Curr.	CF1
Vascular Surgery	Average	18.6	16.8	13.7	12.5	18.2	17.7	37.2	28.8	38.8	24.5	23.5	21.5
	95th %tile	30.9	28.0	25.1	23.0	40.6	34.0	86.3	61.2	78.1	42.3	44.3	39.1
PPCI	Average	14.8	16.0	11.2	12.1	18.6	17.7	30.7	31.0	53.3	25.8	21.4	21.5
	95th %tile	29.9	26.0	22.5	22.6	35.7	32.5	61.7	59.7	78.9	45.4	44.8	39.4
Hyper Acute Stroke	Average	11.5	16.6	12.0	13.0	15.5	19.0	21.7	31.6	23.2	25.9	17.4	21.0
	95th %tile	19.5	26.9	22.4	22.5	29.8	33.7	37.9	61.1	48.8	46.2	30.9	38.8

Distribution of travel times, West Midlands Region: Baseline and Configuration 1









Supply levels and travel times under proposed configuration 2

Configuration 2

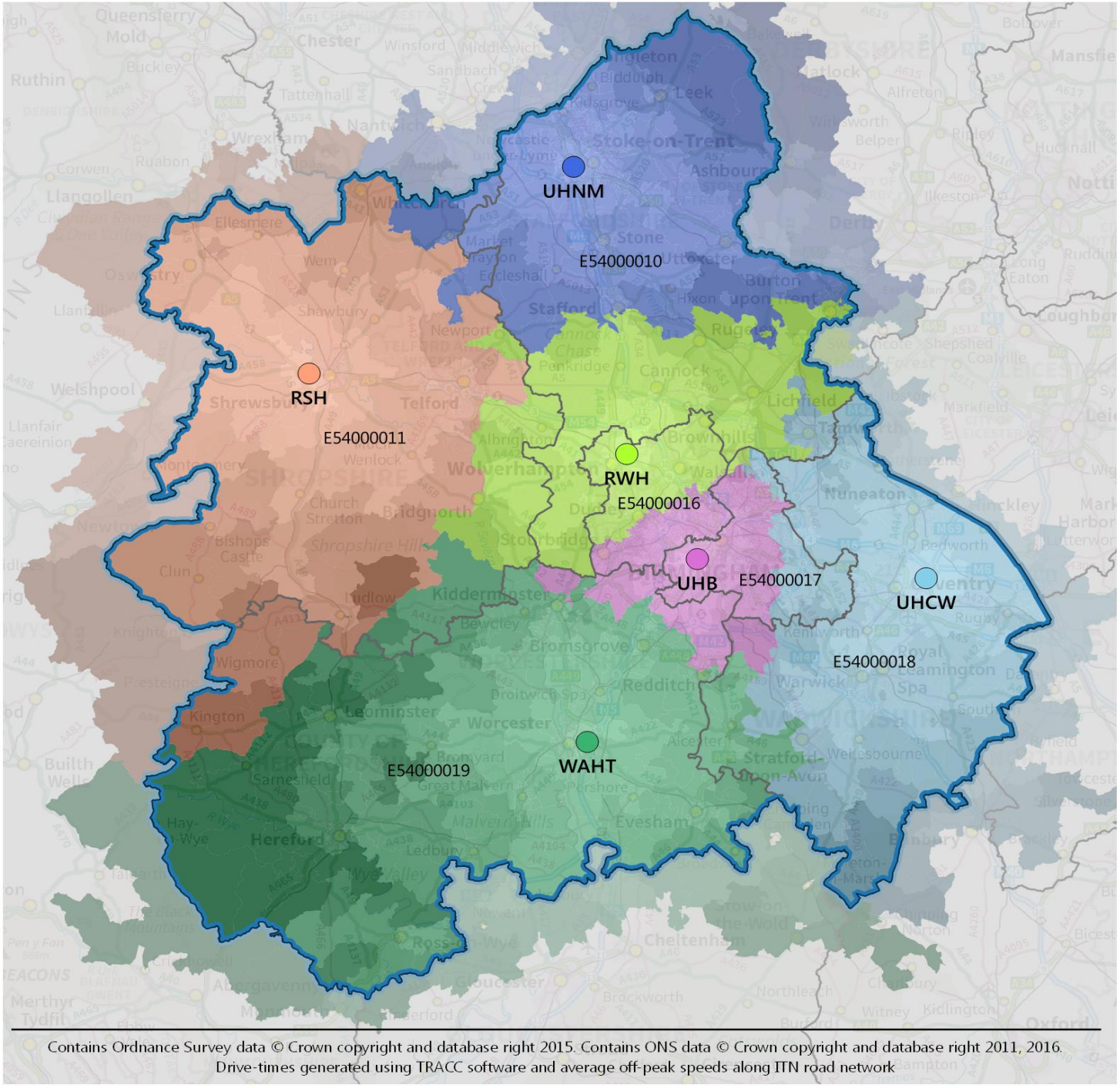
Vascular Surgery, PPCI and Hyper Acute Stroke Services delivered at 6 sites;

- New Cross, Wolverhampton
- QE, Birmingham
- UHCW, Coventry
- Worcestershire Royal
- Royal Shrewsbury
- Royal Stoke

Configuration 2 removes Heartlands Hospital from the list of potential providers. As such, this analysis represents a re-distribution of that site's activity from configuration 1 to the surrounding sites.

Wolverhampton, Stoke and Worcestershire sites are largely unaffected by this variation due to their proximity to Heartlands and the position of remaining alternative providers.

Map – nearest provider by Lower Super Output Areas



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Drive-times generated using TRACC software and average off-peak speeds along ITN road network

West Midlands Specialist Acute Services Configuration 2

NHS

Code:	Site description:
~~BHH~~	~~Heartlands Hospital~~
RSH	Royal Shrewsbury Hospital
RWH	Royal Wolverhampton Hospital
UHB	QE, Birmingham
UHCW	University Hospital, Coventry
UHNM	Royal Stoke University Hospital
WAHT	Worcestershire Royal Hospital

<10 10-19 20-29 30-39 40-49 50-59 60+

Nearest site drive times by Lower Super Output Area (minutes)

Code:	STP description:
E54000010	STAFFORDSHIRE
E54000011	SHROPSHIRE AND TELFORD & WREKIN
E54000016	THE BLACK COUNTRY
E54000017	BIRMINGHAM AND SOLIHULL
E54000018	COVENTRY AND WARWICKSHIRE
E54000019	HEREFORDSHIRE AND WORCESTERSHIRE

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Vascular Surgery

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**180**	**100**				10	60
Birmingham and Solihull	QE, Birmingham	**230**	80	**140**		10		
Coventry & Warwickshire	UHCW, Coventry	**190**		20	**140**			20
Hereford & Worcestershire	Worcestershire Royal	**120**			10	**110**		
Shropshire & Telford	Royal Shrewsbury	**60**					**50**	
Staffordshire	Royal Stoke	**140**						**140**
Total		**910**	**180**	**170**	**150**	**120**	**70**	**220**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

Primary Percutaneous Coronary Intervention

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**850**	**600**	10			20	210
Birmingham and Solihull	QE, Birmingham	**1760**	510	**1160**	10	80		
Coventry & Warwickshire	UHCW, Coventry	**940**		220	**620**			100
Hereford & Worcestershire	Worcestershire Royal	**500**			20	**470**	10	
Shropshire & Telford	Royal Shrewsbury	**150**				10	**140**	
Staffordshire	Royal Stoke	**570**					10	**560**
Total		**4770**	**1120**	**1390**	**640**	**560**	**180**	**870**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

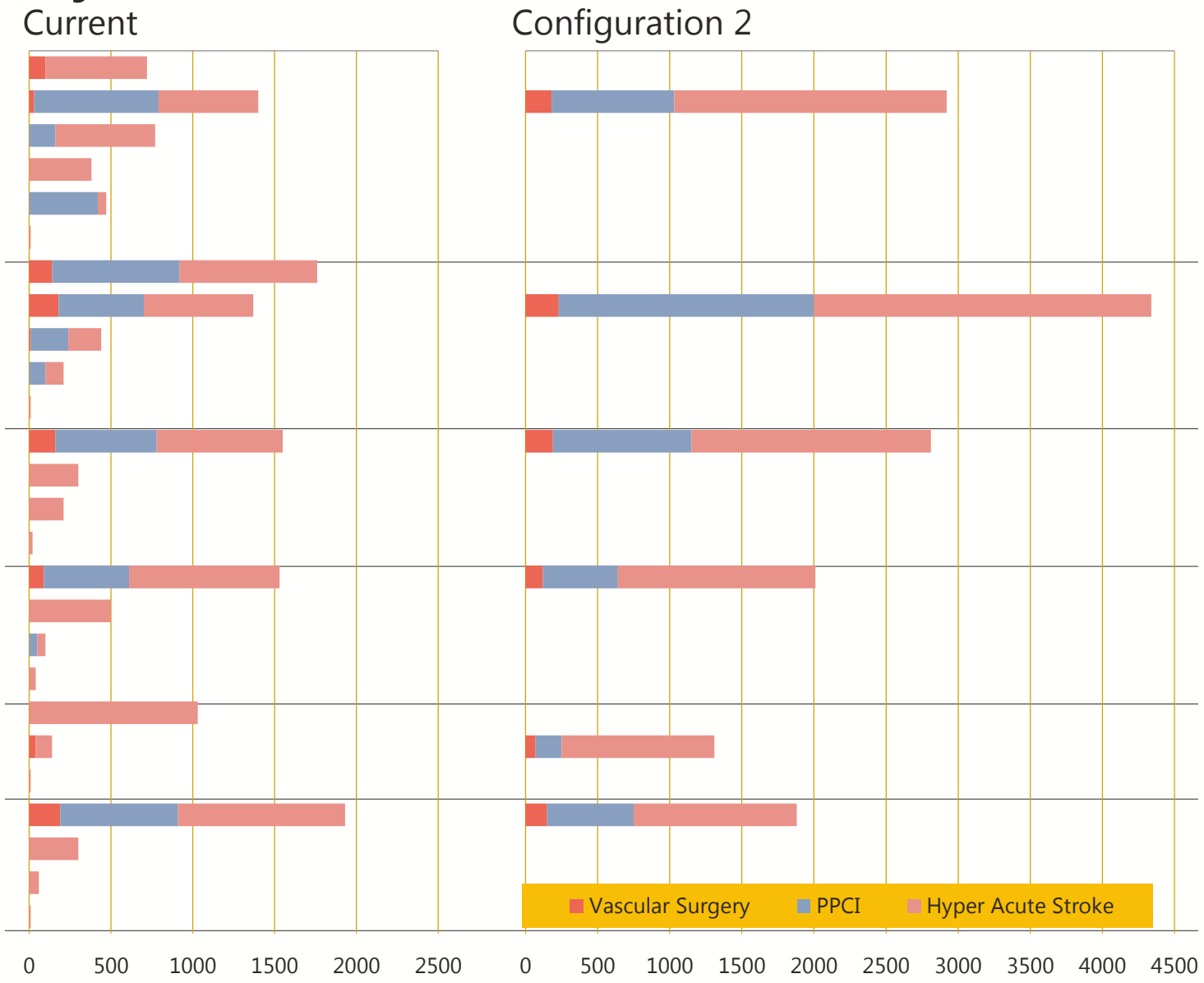
Hyper Acute Stroke

			STP of Patient					
STP of Hospital	Hospital	**Total Spells**	Black C & W. Birmingham	Birmingham and Solihull	Coventry & Warwickshire	Hereford & Worces.	Shropshire & Telford	Staffordshire
Black Country & West Birmingham	New Cross, Wolverhampton	**1880**	**1190**	10			110	560
Birmingham and Solihull	QE, Birmingham	**2340**	780	**1440**	20	100		
Coventry & Warwickshire	UHCW, Coventry	**1630**	10	270	**1250**			110
Hereford & Worcestershire	Worcestershire Royal	**1350**		10	60	**1270**	20	
Shropshire & Telford	Royal Shrewsbury	**900**				20	**880**	
Staffordshire	Royal Stoke	**1060**					60	**1000**
Total		**9170**	**1980**	**1730**	**1320**	**1400**	**1070**	**1670**

Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

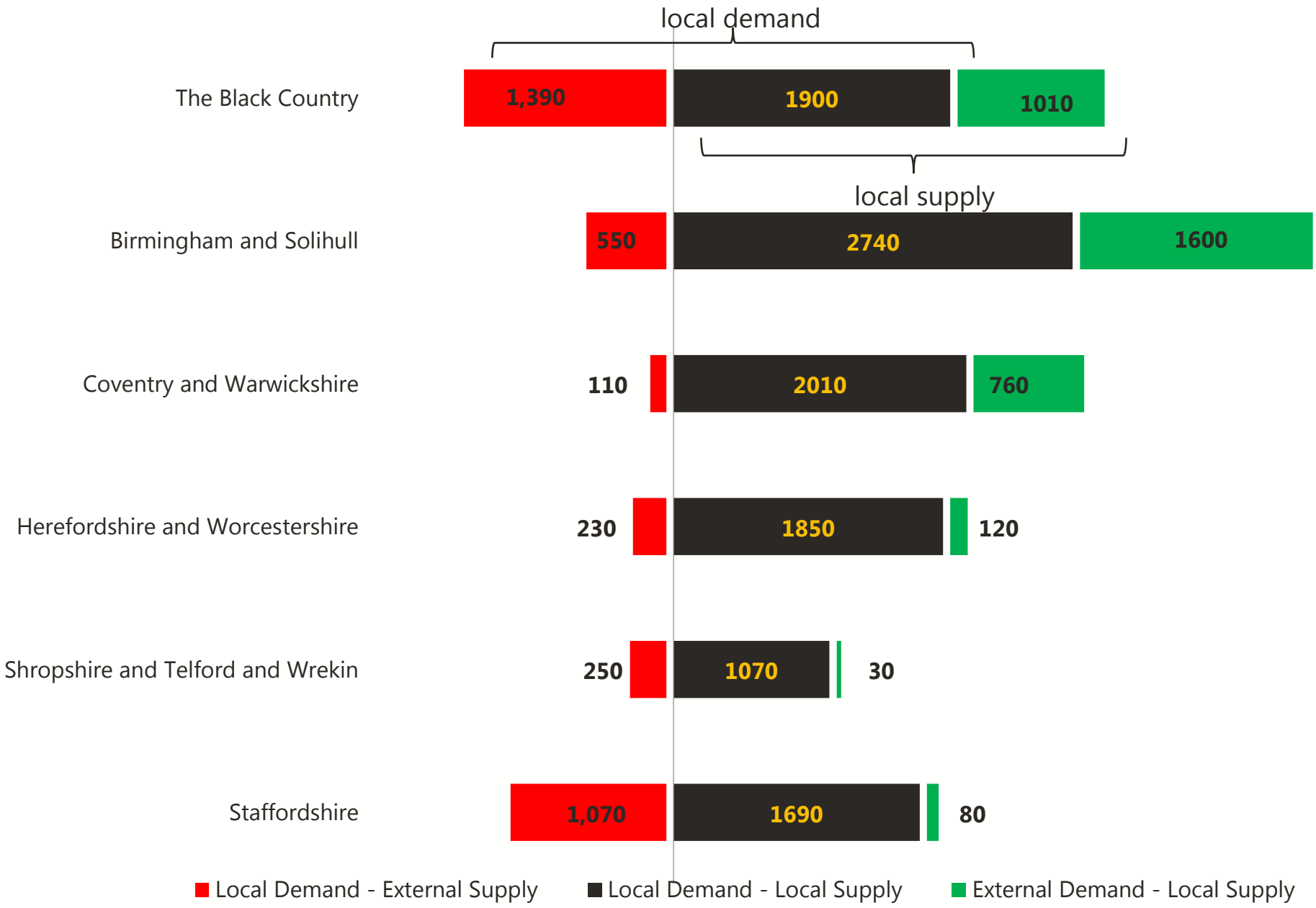
Redistribution of Spells by Provider

Black Country & West Birmingham	Russells Hall, Dudley
	New Cross, Wolverhampton
	Sandwell
	Manor, Walsall
	City, Birmingham
	Other
Birmingham and Solihull	Heartlands, Birmingham
	QE, Birmingham
	Good Hope, Birmingham
	Solihull
	Other
Coventry & Warwickshire	University, Coventry
	Warwick
	George Eliot, Nuneaton
	Other
Hereford & Worcestershire	Worcestershire Royal
	Hereford Country
	Alexandra, Redditch
	Other
Shropshire & Telford	Princess Royal, Telford
	Royal Shrewsbury
	Other
Staffordshire	Royal Stoke
	Queens, Burton
	Country, Stafford
	Other



Numbers rounded to the nearest 10 spells.
Numbers may not sum to totals due to rounding.

Importing and Exporting Activity



The Black Country & West Birmingham – Activity taking place in the STP

Current Configuration	New Cross, Wolverhampton Spells	Russells Hall, Dudley Spells	Sandwell Spells	Manor, Walsall Spells	City, Birmingham Spells
Vascular Surgery	30	100			
PPCI	760		160		420
Hyper Acute Stroke	610	620	610	380	50
Other relevant activity					
non-emergency transfers (PPCI, HAS)	140	10	10	10	10
other emergency cerebro-vascular (inc. TIA)	200	260	200	150	30
Elective PCI	390		50		290

Proposed Configuration **New Cross, Wolverhampton**	Annual Spells	Weekly spells Mean	(95% CI)	*Of which* Emergency Out of Hours	Annual Bed days
Vascular Surgery	180	3	(0 - 7)	0.4	1800
PPCI	850	16	(8 - 24)	8	4400
Hyper Acute Stroke	1880	36	(24 - 48)	12	29900

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Birmingham and Solihull – Activity taking place in the STP

Current Configuration	QE Birmingham Spells	Heartlands Birmingham Spells	Good Hope Birmingham Spells	Solihull Spells
Vascular Surgery	180	140	10	
PPCI	520	780	230	100
Hyper Acute Stroke	670	840	200	110
Other relevant activity				
non-emergency transfers (PPCI, HAS)	60		10	
other emergency cerebro-vascular (inc. TIA)	320	380	140	60
Elective PCI	260	540	10	20

Proposed Configuration **QE Birmingham**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	230	4	(0 - 9)	0.4	1900
PPCI	1760	34	(22 - 45)	15	10400
Hyper Acute Stroke	2340	45	(32 - 58)	16	38300

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Coventry and Warwickshire – Activity taking place in the STP

Current Configuration	University Coventry	Warwick	George Eliot Nuneaton
Vascular Surgery	160		
PPCI	620		
Hyper Acute Stroke	770	300	210
Other relevant activity			
non-emergency transfers (PPCI, HAS)	160	20	10
other emergency cerebro-vascular (inc. TIA)	470	120	90
Elective PCI	190		

Proposed Configuration **University, Coventry**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	190	4	(0 - 7)	0.4	1700
PPCI	940	18	(10 - 26)	8	5100
Hyper Acute Stroke	1630	31	(20 - 42)	11	35400

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Hereford & Worcestershire – Activity taking place in the STP

Current Configuration	Worcestershire Royal	Hereford County	Alexandra Redditch
Vascular Surgery	90		
PPCI	520		50
Hyper Acute Stroke	920	500	50
Other relevant activity			
non-emergency transfers (PPCI, HAS)	140		
other emergency cerebro-vascular (inc. TIA)	290	170	30
Elective PCI	200		

Proposed Configuration **Worcestershire Royal**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	120	2	(0 - 5)	0.2	1500
PPCI	500	10	(4 - 16)	5	2200
Hyper Acute Stroke	1350	26	(16 - 36)	9	20600

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Shropshire and Telford – Activity taking place in the STP

Current Configuration	Royal Shrewsbury	Princess Royal Telford
Vascular Surgery	40	
PPCI		
Hyper Acute Stroke	100	1030
Other relevant activity		
non-emergency transfers (PPCI, HAS)		
other emergency cerebro-vascular (inc. TIA)	80	370
Elective PCI		

Proposed Configuration **Royal Shrewsbury**	Annual Spells	Weekly spells		*Of which* Emergency Out of Hours	Annual Bed days
		Mean	(95% CI)		
Vascular Surgery	60	1	(0 - 3)	0.1	500
PPCI	150	3	(0 - 6)	2	600
Hyper Acute Stroke	900	17	(9 - 25)	7	12900

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Staffordshire – Activity taking place in the STP

Current Configuration	Royal Stoke	Queens Burton	County Stafford
Vascular Surgery	190		
PPCI	720		
Hyper Acute Stroke	1020	300	60
Other relevant activity			
non-emergency transfers (PPCI, HAS)	470		80
other emergency cerebro-vascular (inc. TIA)	390	180	40
Elective PCI	500		

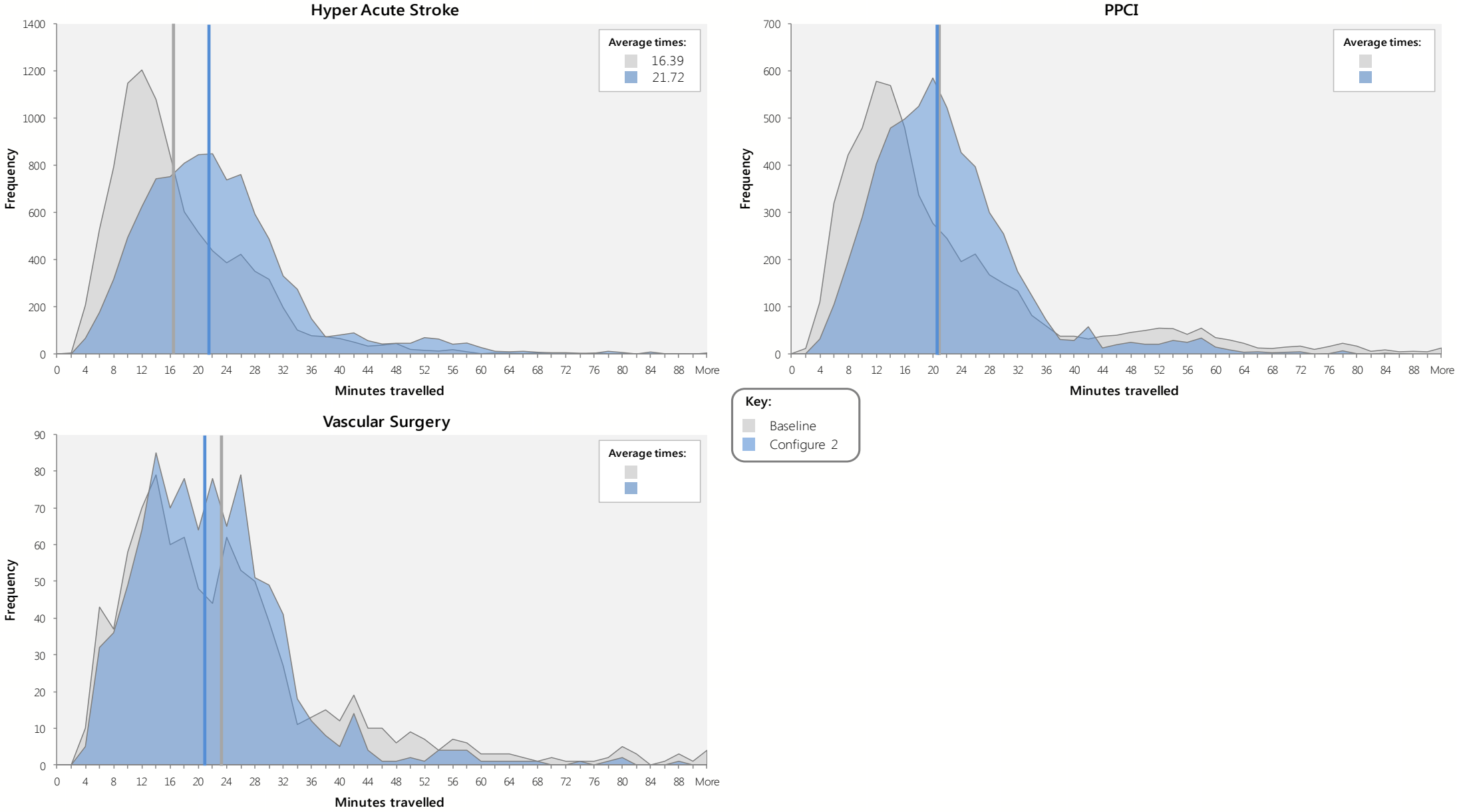
Proposed Configuration **Royal Stoke**	Annual Spells	Weekly spells Mean	(95% CI)	*Of which* Emergency Out of Hours	Annual Bed days
Vascular Surgery	140	3	(0 - 6)	0.4	1500
PPCI	570	11	(4 - 17)	5	2600
Hyper Acute Stroke	1060	20	(12 - 29)	7	11600

Spells rounded to the nearest 10.
Bed days rounded to the nearest 100.
Bed days are overnight stays.

Travel Times by STP of patient

		Black C & W. Birmingham		Birmingham and Solihull		Coventry & Warwickshire		Hereford & Worcestershire		Shropshire & Telford		Staffordshire	
		Curr.	CF2	Curr.	CF2	Curr.	CF2	Curr.	CF2	Curr.	CF2	Curr.	CF2
Vascular Surgery	Average	18.6	17.1	13.7	17.7	18.2	17.9	37.2	28.8	38.8	24.5	23.5	22.4
	95th %tile	30.9	28.0	25.1	27.3	40.6	34.0	86.3	61.2	78.1	42.3	44.3	41.0
PPCI	Average	14.8	16.5	11.2	18.5	18.6	18.0	30.7	31.0	53.3	25.8	21.4	22.3
	95th %tile	29.9	26.1	22.5	27.0	35.7	32.5	61.7	59.7	78.9	45.4	44.8	41.5
Hyper Acute Stroke	Average	11.5	17.0	12.0	18.6	15.5	119.2	21.7	31.6	23.2	25.9	17.4	21.6
	95th %tile	19.5	27.0	22.4	27.0	29.8	33.7	37.9	61.1	48.8	46.2	30.9	40.5

Distribution of travel times, West Midlands Region: Baseline and Configuration 2



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Appendix 1 – Stroke and AMI Mimics

Title	Source	Authors	Abstract	URL
Predictors of acute stroke mimics in 8187 patients referred to a stroke service.	Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association; Nov 2013; vol. 22 (no. 8); p. e397	Merino, José G; Luby, Marie; Benson, Richard T; Davis, Lisa A; Hsia, Amie W; Latour, Lawrence L; Lynch, John K; Warach, Steven	Some patients seen by a stroke team do not have cerebrovascular disease but a condition that mimics stroke. The purpose of this study was to determine the rate and predictors of stroke mimics in a large sample. This is an analysis of data from consecutive patients seen by the National Institutes of Health Stroke Program over 10 years. Data were collected prospectively as a quality improvement initiative. Patients with a cerebrovascular event or a stroke mimic were compared with the Student t or Pearson chi-square test as appropriate, and logistic regression was done to identify independent predictors. The analysis included 8187 patients: 30% had a stroke mimic. Patients with a stroke mimic were younger, and the proportion of patients with a stroke mimic was higher among women, patients without any risk factors, those seen as a code stroke or who arrived to the emergency department via personal vehicle, and those who had the onset of symptoms while inpatients. The proportion of patients with a stroke mimic was marginally higher among African-Americans than Caucasians. Factors associated with the greatest odds of having a stroke mimic in the logistic regression were lack of a history of hypertension, atrial fibrillation or hyperlipidemia. One third of the patients seen by a stroke team over 10 years had a stroke mimic. Factors associated with a stroke mimic may be ascertained by an emergency physician before calling the stroke team. Copyright © 2013 National Stroke Association. All rights reserved.	https://www.ncbi.nlm.nih.gov/pubmed/23680681

Title	Source	Authors	Abstract	URL
Identification of stroke mimics in the emergency department setting.	Journal of brain disease; 2009; vol. 1 ; p. 19-22	Tobin, W Oliver; Hentz, Joseph G; Bobrow, Bentley J; Demaerschalk, Bart M	Previous studies have shown a stroke mimic rate of 9%-31%. We aimed to establish the proportion of stroke mimics amongst suspected acute strokes, to clarify the aetiology of stroke mimic and to develop a prediction model to identify stroke mimics. This was a retrospective cohort observational study. Consecutive "stroke alert" patients were identified over nine months in a primary stroke centre. 31 variables were collected. Final diagnosis was defined as "stroke" or "stroke mimic". Multivariable regression analysis was used to define clinical predictors of stroke mimic. 206 patients were reviewed. **22% were classified as stroke mimics.** Multivariable scoring did not help in identification of stroke mimics. 99.5% of patients had a neurological diagnosis at final diagnosis. 22% of patients with suspected acute stroke had a stroke mimic. The aetiology of stroke mimics was varied, with seizure, encephalopathy, syncope and migraine being commonest. Multivariable scoring for identification of stroke mimics is not feasible. 99.5% of patients had a neurological diagnosis. This strengthens the case for the involvement of stroke neurologists/stroke physicians in acute stroke care.	https://www.ncbi.nlm.nih.gov/pubmed/23818805

Title	Source	Authors	Abstract	URL
[Hospitalization of non-stroke patients in a Stroke Unit].	Deutsche medizinische Wochenschrift (1946); Apr 2004; vol. 129 (no. 14); p. 731-735	Heckmann, J G; Stadter, M; Dütsch, M; Handschu, R; Rauch, C; Neundörfer, B	Stroke care in Germany has substantially improved during the last decade. One column of modern stroke care is the institution of stroke unit which allows rapid diagnosis and treatment. The aspect of admission of nonstroke patients to a stroke unit is poorly evaluated. The aim of this study is to evaluate the number of patients who are admitted to a national stroke unit but do not suffer from stroke. Furthermore, we related the proportion of nonstroke referrals to the different referral modes. Observational study recording all suspected stroke referrals with regard to final diagnosis and type of referral during a 12-month period (1.8.2002-31.7.2003). 462 patients were admitted by 4 routes: 74 by paramedics or by self-presentation, 138 by emergency physicians, 144 by primary care doctors, and 106 were transferred from other hospitals. **88 patients (19 %) finally revealed no acute stroke.** The most common nonstroke diagnoses were seizure (20 %), dissociative disorders (14 %), cranial nerve disorders (11 %), hypoglycaemia (8 %) and transient global amnesia (7 %). There was no significant difference among the proportion of nonstroke patients referred by ambulance paramedics and self-presentation (15 %), emergency physicians (21 %), primary care doctors (15 %) and interhospital transfer (24 %) [p = 0.222, X (2)-test according to Pearson]. Due to the fact that a number of clinical neurological conditions mimic acute stroke, misdiagnosis of stroke is common. We advocate that all stroke patients are seen early in the course of the disease by a neurologist. An alternative could be that in stroke units of internal medicine hospitals patients are seen by a consulting neurologist. Alternatively, telemedicine might be used and the neurologist on duty of a neurological stroke unit could be consulted.	https://www.ncbi.nlm.nih.gov/pubmed/15042487

Title	Source	Authors	Abstract	URL
[Stroke mimics: a challenge for the emergency physician].	Anales del sistema sanitario de Navarra; 2014; vol. 37 (no. 1); p. 117-128	Valle, J; Lopera, E; Guillán, M; Muñoz, M C; Sánchez, A; Hernández, Y	To study the number of patients diagnosed with a stroke in the emergency service of a first level hospital and the proportion of these patients who were finally stroke mimics, as well as to describe and analyze the variables that can help in differential diagnosis in hospital emergency services. Nine month prospective study. All patients evaluated in emergency services and admitted with a diagnosis of stroke were included. Different clinical variables were analyzed that included prior history, history of the current event, general physical and neurological examination, NIHSS classification and Oxfordshire Community Stroke Project Classification. The final diagnosis was made by a panel of experts with access to clinical characteristics, image studies and other tests. The univariate and multivariate analysis determined the characteristics that help in distinguishing strokes from stroke mimics. One hundred and forty-four cases of stroke were registered; the final sample was made up of 140 patients. **The final diagnosis was stroke in 103 out of 140 (73.6%) and stroke mimic in the rest.** Eleven variables predicted the diagnosis in patients with a suspected stroke: age over 70 years (p=0.012), NIHSS classification > 5, reaching a clinical classification (p=0.019) capable of determining the exact start (p=0.000), abnormal vascular findings (p=0.014), gaze deviation (p=0.042), sight loss (p=0.052) and extensor plantar response (p=0.025) favored diagnosis of stroke, while epileptic seizures (p=0.029), neurological symptoms not congruent with the vascular territory (p=0.022) and abnormal findings in other systems (p=0.14) favored diagnosis of stroke mimic. Stroke mimics constitute one-third of the patients admitted from emergency services as strokes, with a highly varied etiology. Achieving a suitable clinical history and a precise physical examination is of great importance and can help less experienced doctors.	https://www.ncbi.nlm.nih.gov/pubmed/24871117

Title	Source	Authors	Abstract	URL
Differentiation of true transient ischemic attack versus transient ischemic attack mimics.	Iranian journal of neurology; Jul 2014; vol. 13 (no. 3); p. 127-130	Noureddine, Ali; Ghandehari, Kavian; Taghi Shakeri, Mohammad	Previous literatures have shown a transient ischemic attack (TIA) mimic rate of 9-31%. We aimed to ascertain the proportion of stroke mimics amongst suspected TIA patients. A prospective observational study was performed in Ghaem Hospital, Mashhad, Iran during 2012-2013. Consecutive TIA patients were identified in a stroke center. The initial diagnosis of TIA was made by the resident of neurology and final diagnosis of true TIA versus TIA mimics was made after 3 months follow-up by stroke subspecialist. A total of 310 patients were assessed during a 3-month period of which 182 (58.7%) subjects were male and 128 (41.3%) were female. **Ten percent of the patients was categorized as a TIA mimic.** The presence of hypertension, aphasia, duration of symptoms, and increased age was the strongest predictor of a true TIA. Migraine was the most common etiology of stroke mimic in our study. It seems that many signs and symptoms have low diagnostic usefulness for discrimination of true TIA from non-cerebrovascular events and predictive usefulness of any sign or symptom should be interpreted by a stroke neurologist.	https://www.ncbi.nlm.nih.gov/pubmed/25422730

Title	Source	Authors	Abstract	URL
Conditions mimicking acute ST-segment elevation myocardial infarction in patients referred for primary percutaneous coronary intervention	Neth Heart J. 2008 Oct; 16(10): 325–331.	Y.L. Gu, T. Svilaas, I.C.C. van der Horst, and F. Zijlstra	Background/Objectives: A rapid diagnosis of ST-segment elevation myocardial infarction (STEMI) is mandatory for optimal treatment. However, a small proportion of patients with suspected STEMI suffer from other conditions. Although case reports have described these conditions, a contemporary systematic analysis is lacking. We report the incidence, clinical characteristics and outcome of patients with suspected STEMI referred for primary percutaneous coronary intervention (PCI) with a final diagnosis other than STEMI. Methods: From January 2004 to July 2005, 820 consecutive patients were included with suspected STEMI who were referred for primary PCI to a university medical centre, based on a predefined protocol. Clinical characteristics, final diagnosis and outcome were obtained from patient charts and databases. Results: **In 19 patients (2.3%), a final diagnosis other than myocardial infarction was established**: coronary aneurysm (n=1), (myo)pericarditis (n=5), cardiomyopathy (n=2), Brugada syndrome (n=1), aortic stenosis (n=1), aortic dissection (n=3), subarachnoidal haemorrhage (n=2), pneumonia (n=1), chronic obstructive pulmonary disease (n=1), mediastinal tumour (n=1), and peritonitis after recent abdominal surgery (n=1). These patients less often reported previous symptoms of angina ($p<0.001$), smoking ($p<0.05$) and a positive family history of cardiovascular diseases ($p<0.05$) than STEMI patients. Mortality at 30 days was 16%. Conclusion: A 2.3% incidence of conditions mimicking STEMI was found in patients referred for primary PCI. A high clinical suspicion of conditions mimicking STEMI remains necessary. (Neth Heart J 2008;16:325-31.)	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2570763/

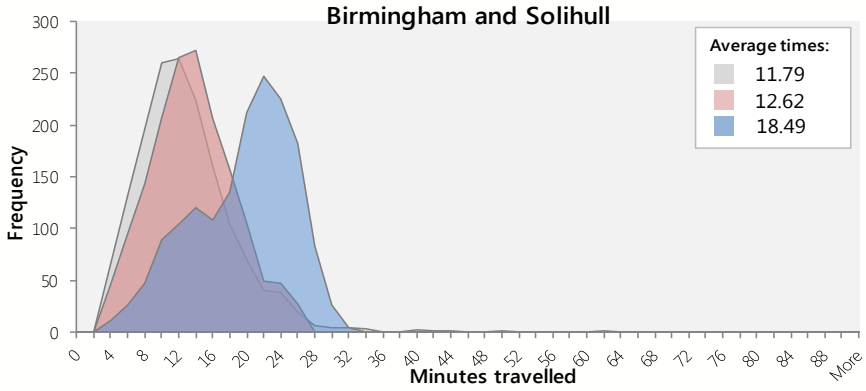
Title	Source	Authors	Abstract	URL
Clinical Significance of Conditions Presenting with ECG Changes Mimicking Acute Myocardial Infarction.	The International journal of angiology : official publication of the International College of Angiology, Inc; Jun 2013; vol. 22 (no. 2); p. 115-122	Yahalom, Malka; Roguin, Nathan; Suleiman, Khaled; Turgeman, Yoav	The electrocardiogram (ECG) is the primary tool in the diagnosis of acute myocardial infarction (AMI). However, other clinical conditions, both cardiac and noncardiac originated pathologies, may result in ECG tracing of AMI. This may lead to an incorrect diagnosis, exposing the patients to unnecessary tests and potentially harmful therapeutic procedures. The aim of this report is to increase the still insufficient awareness of clinicians from multiple disciplines, regarding the different clinical syndromes, both cardiac and noncardiac, associated with ECG abnormalities mimicking AMI, to avoid unjustified thrombolytic therapy or intervention procedures. During a 9-year period, the data from six patients (five females, one male; mean age, 50 years [range, 18 to 78 years]) who were admitted to cardiac care unit (CCU) with transient ECG changes resembling AMI were recorded retrospectively. **During this 9-year period, 5,400 patients were hospitalized in CCU: 1,350 patients were diagnosed as ST-elevation myocardial infarction (STEMI) and 4,050 patients were diagnosed as non-ST-elevation myocardial infarction (NSTEMI).** Only two out of six patients had chest pain with ECG changes criteria suspicious of AMI. STEMI was suspected in four out of six patients. All patients, but one, had normal left ventricular (LV) function. One patient had transient LV dysfunction. All patients, but one, with perimyocarditis, had normal serum cardiac markers. In four out of six patients, who underwent coronary arteries imaging during hospitalization (by angiography or by CT scan), normal coronary arteries were documented. Two patients who underwent ambulatory cardiac CT scan imaging after being discharged from hospital documented patent coronary arteries (case no. 3), or some insignificant irregularities (case no. 4). The discharge diagnoses from CCU were as follows: postictal syndrome, pericarditis, hypothermia, stress-induced ("tako-tsubo") cardiomyopathy, anaphylactic reaction, and status of postchemotherapy. All patients experienced full recovery with normal ECG tracing. During the 5-year follow-up, all patients were alive, and cardiac morbidity was not reported. **We conclude that both cardiac and noncardiac clinical syndromes may mimic AMI.** Comprehensive clinical examination and profound medical history are crucial for making the correct diagnosis in conditions with ECG changes mimicking AMI.	https://www.ncbi.nlm.nih.gov/pubmed/24436595

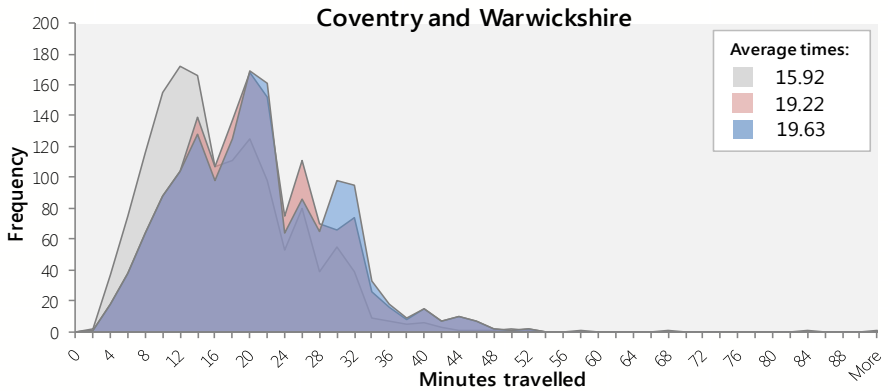
Title	Source	Authors	Abstract	URL
ST segment elevations: always a marker of acute myocardial infarction?	Indian heart journal; 2013; vol. 65 (no. 4); p. 412-423	Coppola, G; Carità, P; Corrado, E; Borrelli, A; Rotolo, A; Guglielmo, M; Nugara, C; Ajello, L; Santomauro, M; Novo, S; Italian Study Group of Cardiovascular Emergencies of the Italian Society of Cardiology	Chest pain is one of the chief presenting complaints among patients attending Emergency department. The diagnosis of acute myocardial infarction may be a challenge. Various tools such as anamnesis, blood sample (with evaluation of markers of myocardial necrosis), ultrasound techniques and coronary computed tomography could be useful. However, the interpretation of electrocardiograms of these patients may be a real concern. **The earliest manifestations of myocardial ischemia typically interest T waves and ST segment. Despite the high sensitivity, ST segment deviation has however poor specificity since it may be observed in many other cardiac and non-cardiac conditions.** Therefore, when ST-T abnormalities are detected the physicians should take into account many other parameters (such as risk factors, symptoms and anamnesis) and all the other differential diagnoses. The aim of our review is to overview of the main conditions that may mimic a ST segment Elevation Myocardial Infarction (STEMI). Copyright © 2013 Cardiological Society of India. Published by Elsevier B.V. All rights reserved.	https://www.ncbi.nlm.nih.gov/pubmed/23993002

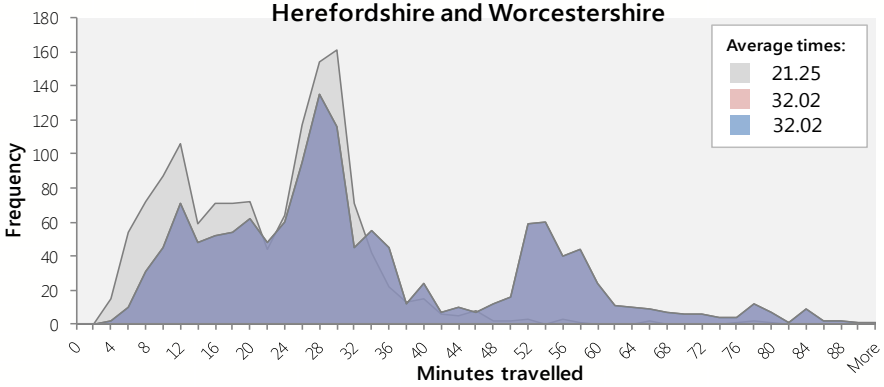
Title	Source	Authors	Abstract	URL
Diagnostic accuracy of ST-segment elevation myocardial infarction by various healthcare providers.	International journal of cardiology; Dec 2014; vol. 177 (no. 3); p. 825-829	Huitema, Ashlay A; Zhu, Tina; Alemayehu, Mistre; Lavi, Shahar	This study aimed to compare the accuracy of ECG interpretation for diagnosis of STEMI by different groups of healthcare professionals involved in the STEMI program at our institution. We selected 21 ECGs from patients with typical symptoms of MI that were diagnosed with STEMI, and 10 ECGs of STEMI mimics. STEMI mimic ECGs were repeated in the package with a story of typical and atypical chest pain. ECGs were interpreted to diagnose STEMI and identify need for initiation of the cardiac catheterization lab (CCL). Participants identified confidence in STEMI recognition, and average number of ECGs read per week. A total of 64 participants completed the study package. Cardiologists were more likely to provide correct interpretation compared to other groups. False positive diagnoses were more likely made by paramedics when compared to cardiologists ($p < 0.01$). There was a positive correlation between increased exposure to ECGs and accurate STEMI diagnosis ($r = 0.482$, $p < 0.001$). A threshold of ≥ 20 ECGs read per week showed a statistically significant improvement in accuracy ($p < 0.001$). Self-reported confidence correlated positively with accuracy ($r = 0.402$, $p =< 0.001$). Changing the ECG narrative of the STEMI mimic ECGs had a significant effect on interpretation between groups ($p = 0.043$). Our study showed that healthcare profession and number of ECGs reviewed per week are predictive of the accuracy of ECG interpretation of STEMI. Cardiologists are the most accurate diagnosticians, and are the least likely to falsely activate the CCL. Weekly exposure of ≥ 20 ECGs may improve diagnostic accuracy regardless of underlying experience. Copyright © 2014 Elsevier Ireland Ltd. All rights reserved.	https://www.ncbi.nlm.nih.gov/pubmed/25465827

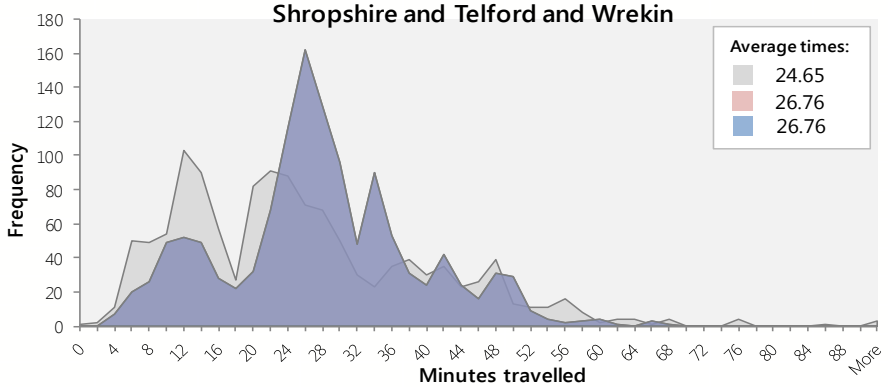
Appendix 2 – Additional Analysis

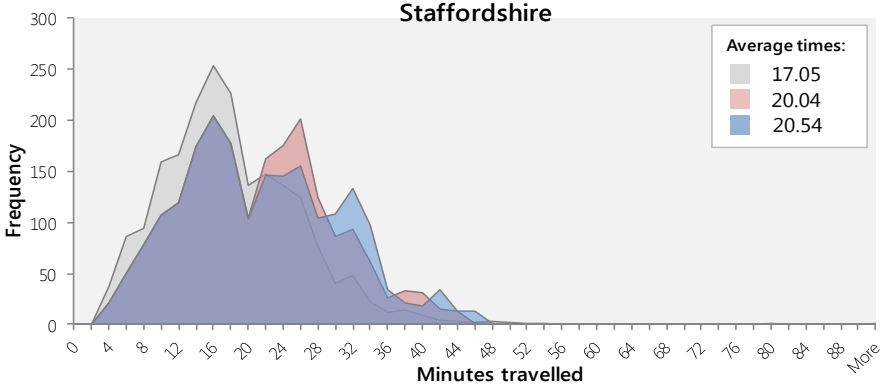
Appendix : Travel-time distribution by STP: Hyper Acute Stroke

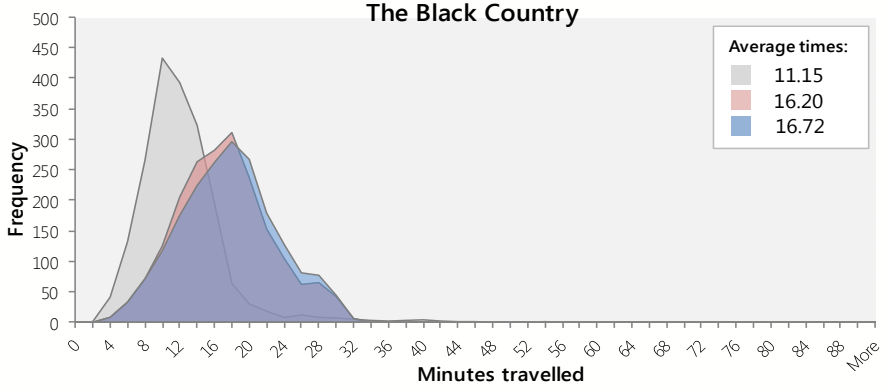






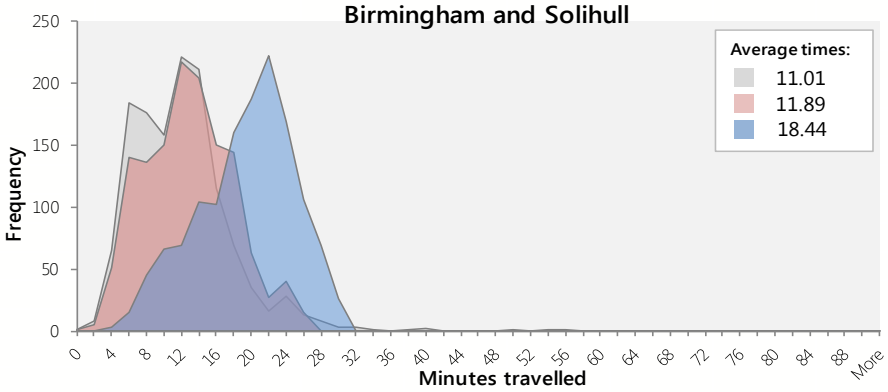


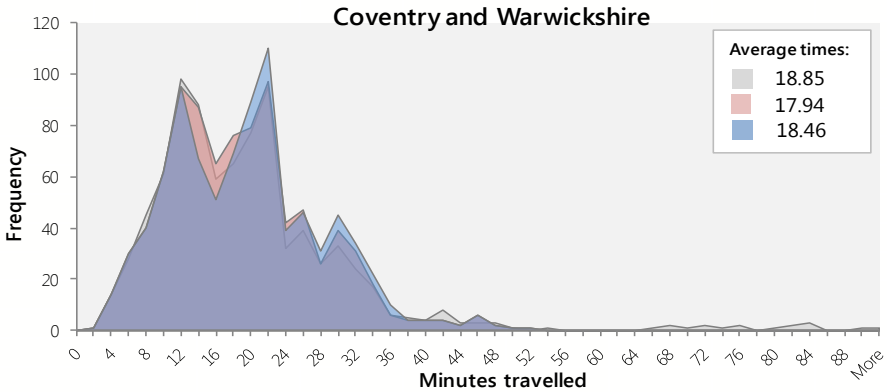


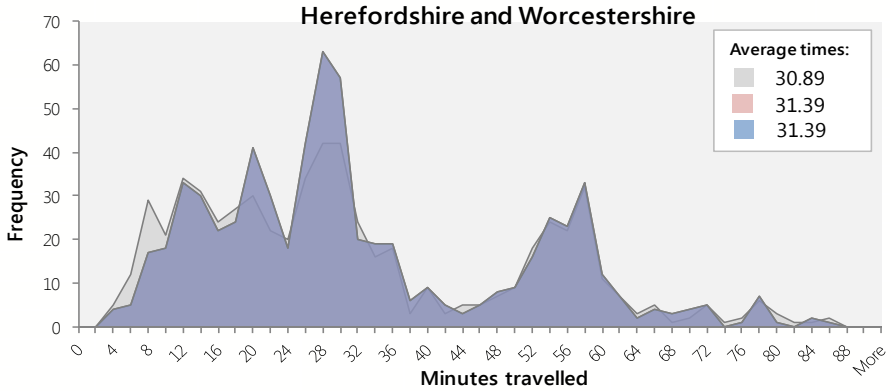


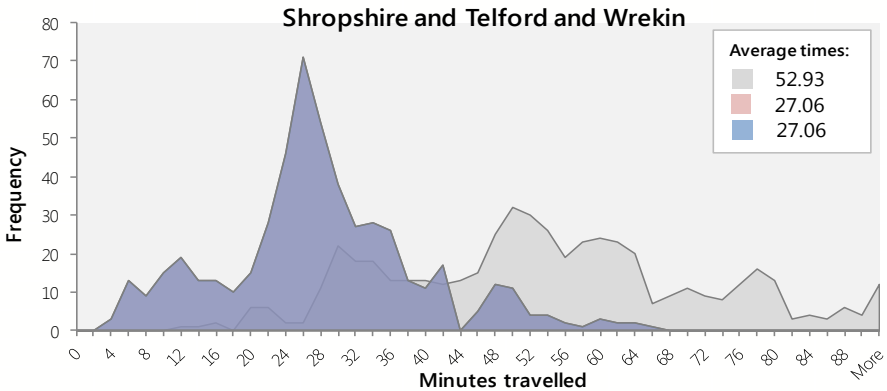
Key:
- Baseline
- Configure 1
- Configure 2

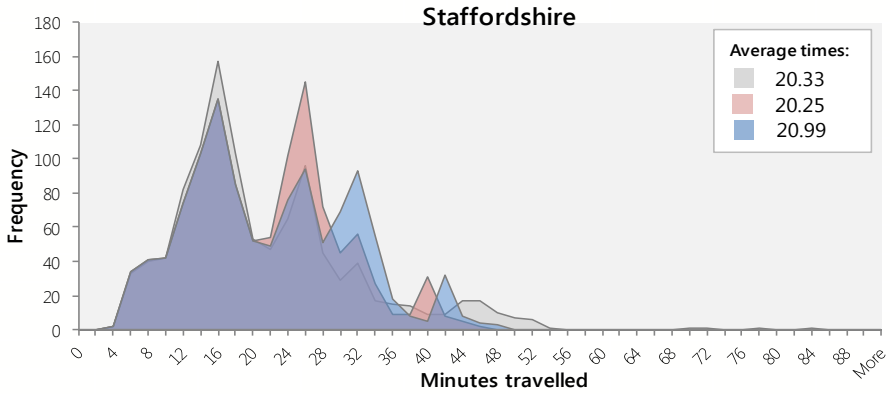
Appendix : Travel-time distribution by STP: PPCI

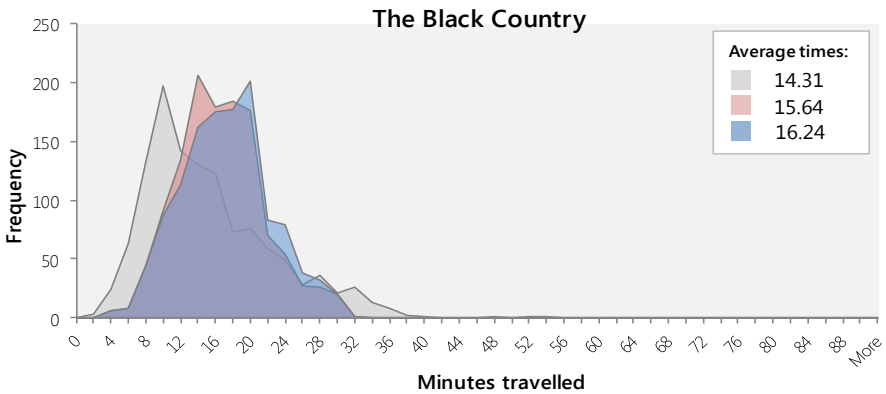






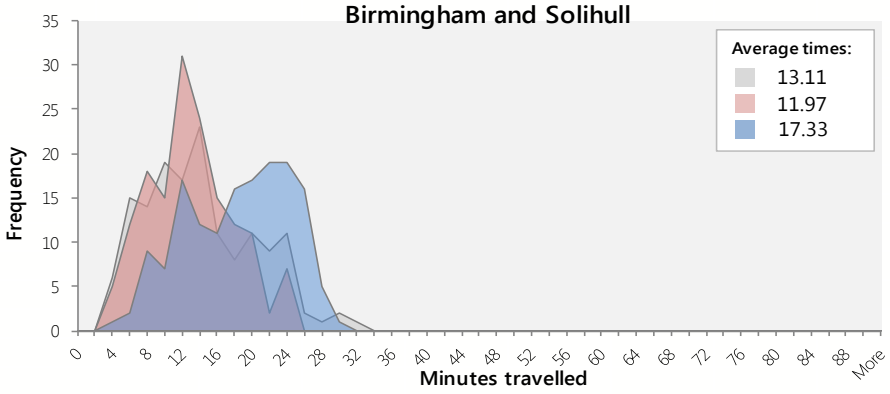


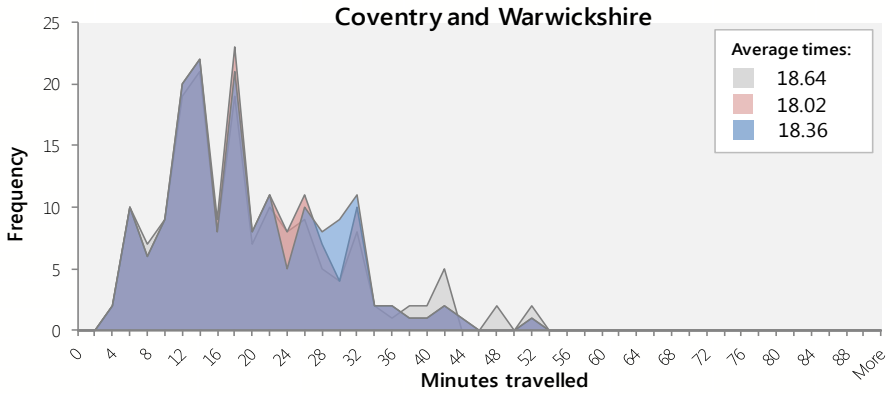


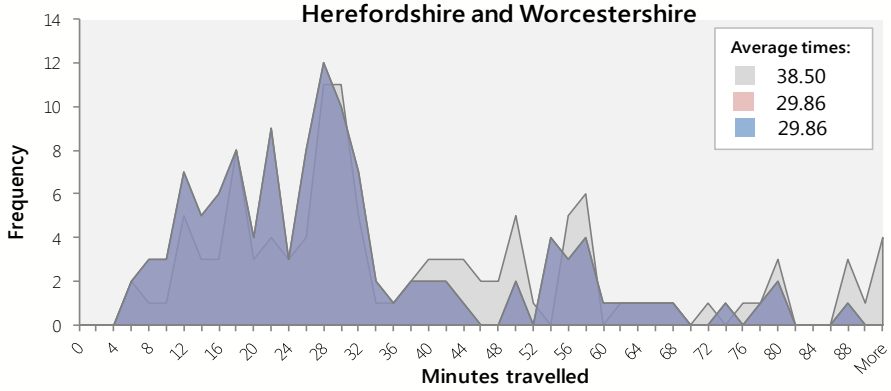


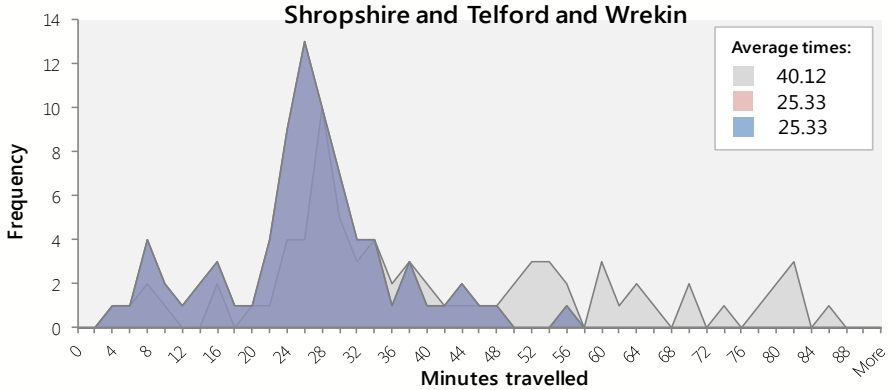
Key:
- Baseline
- Configure 1
- Configure 2

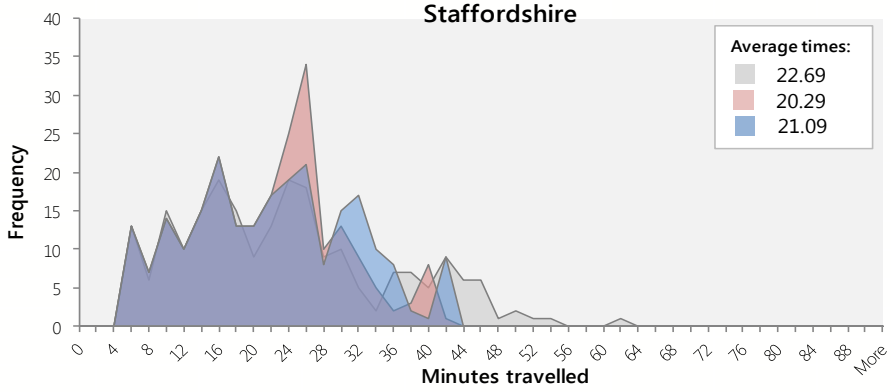
Appendix : Travel-time distribution by STP: Vascular Surgery

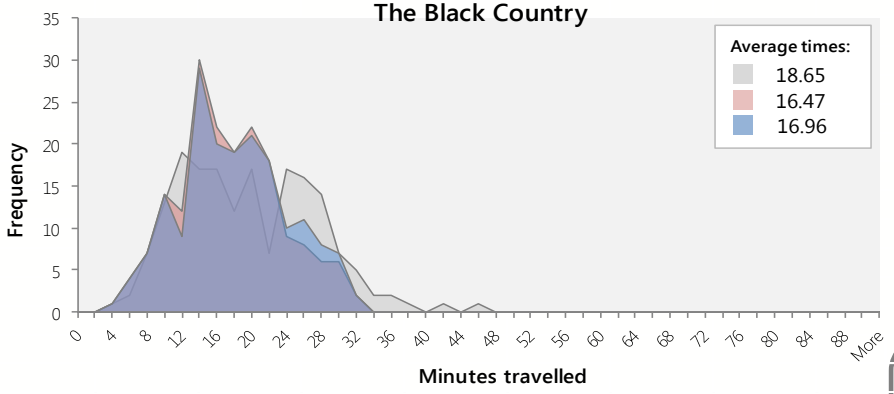








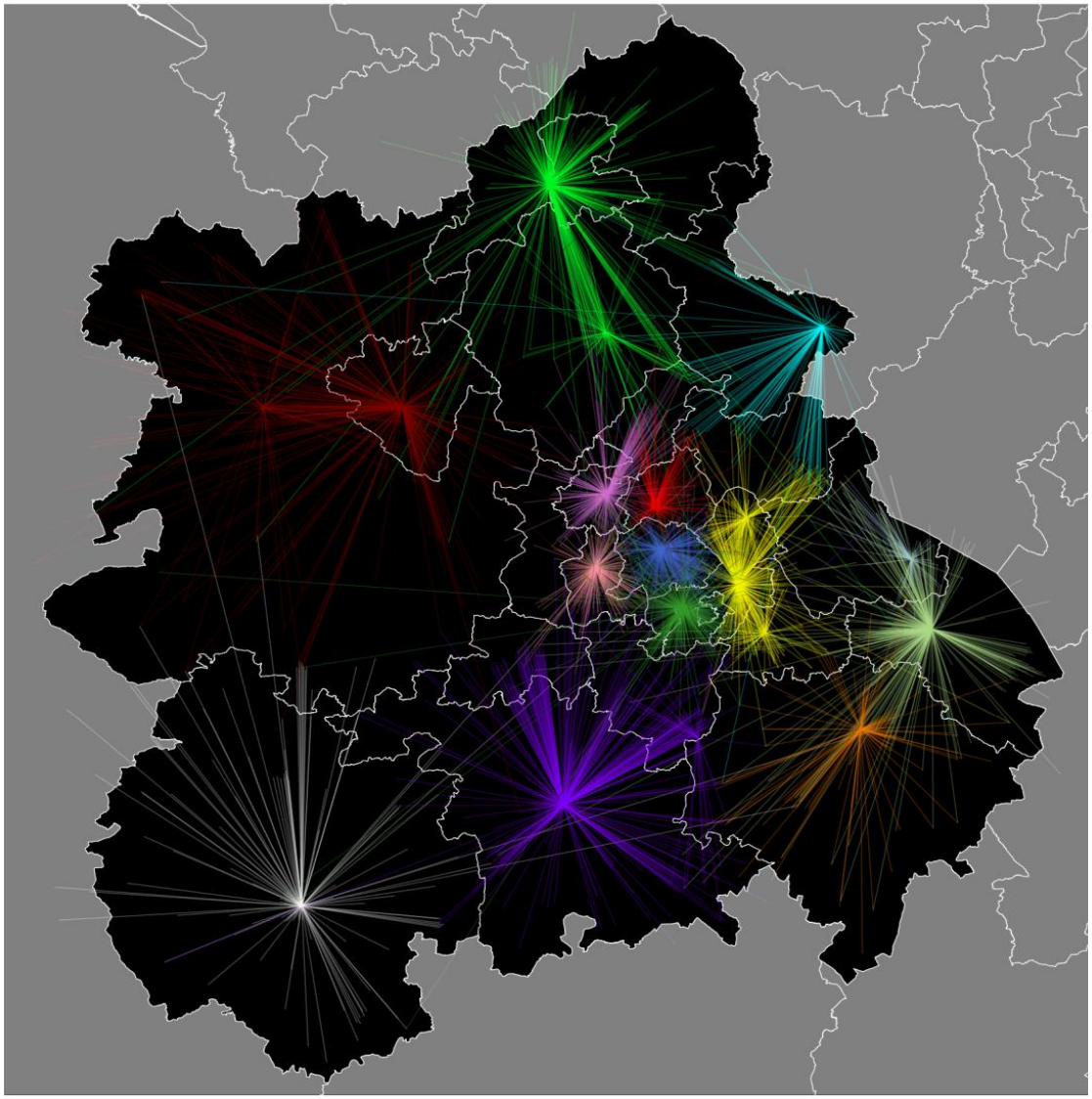




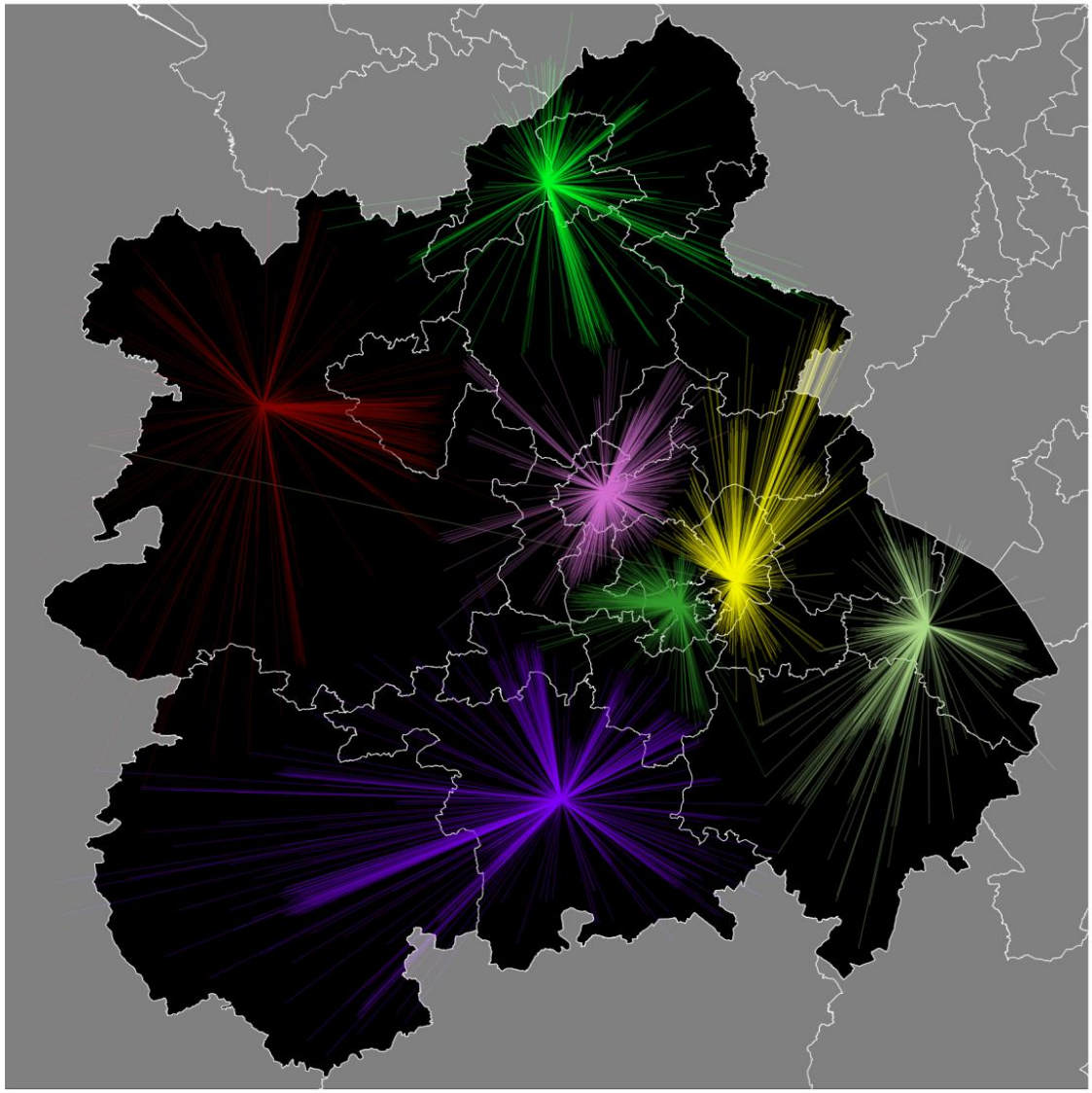
Key:
- Baseline
- Configure 1
- Configure 2

Appendix : Flow maps – Hyper Acute Stroke

Baseline

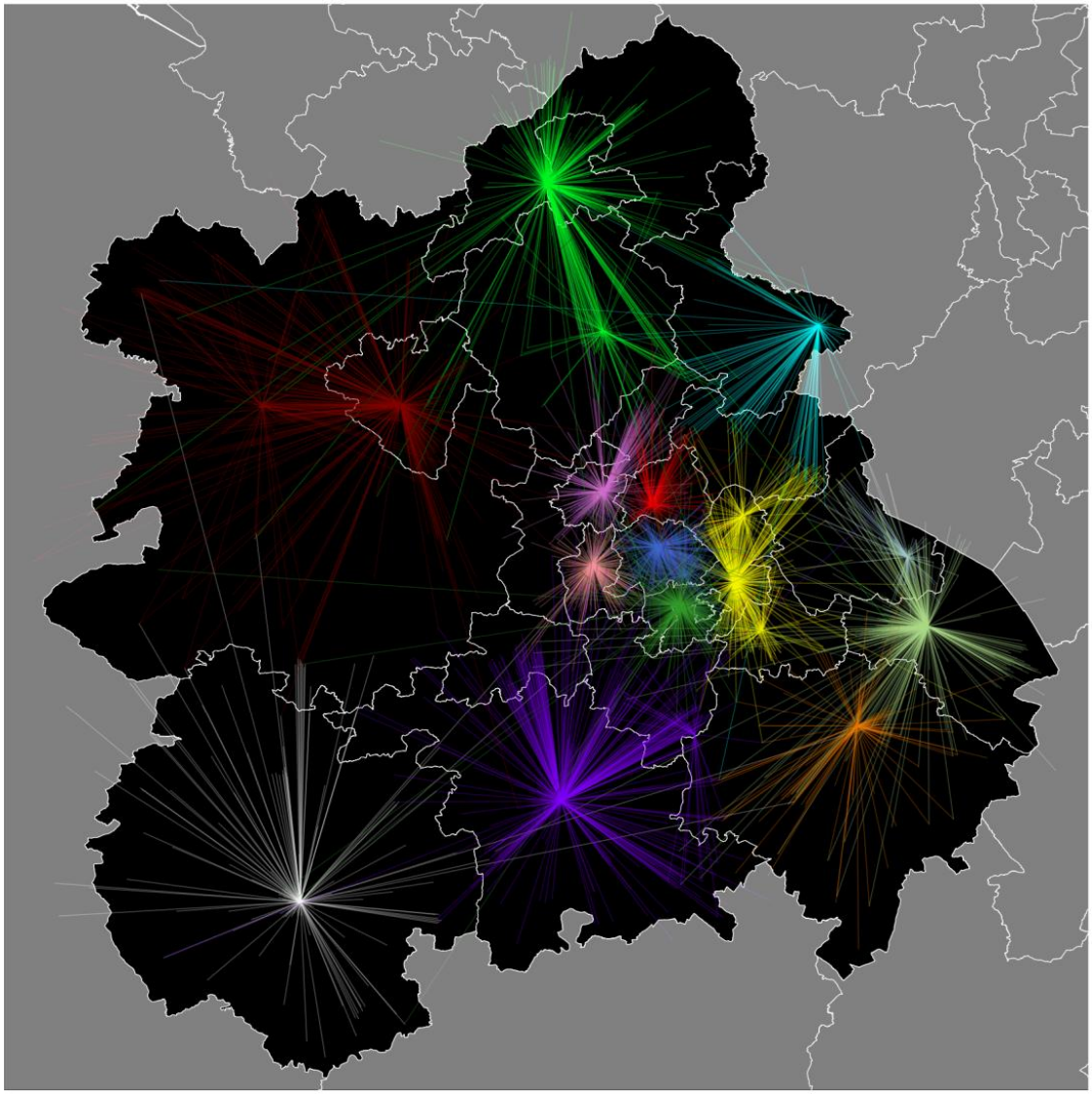


Configuration 1



Appendix : Flow maps – Hyper Acute Stroke

Baseline



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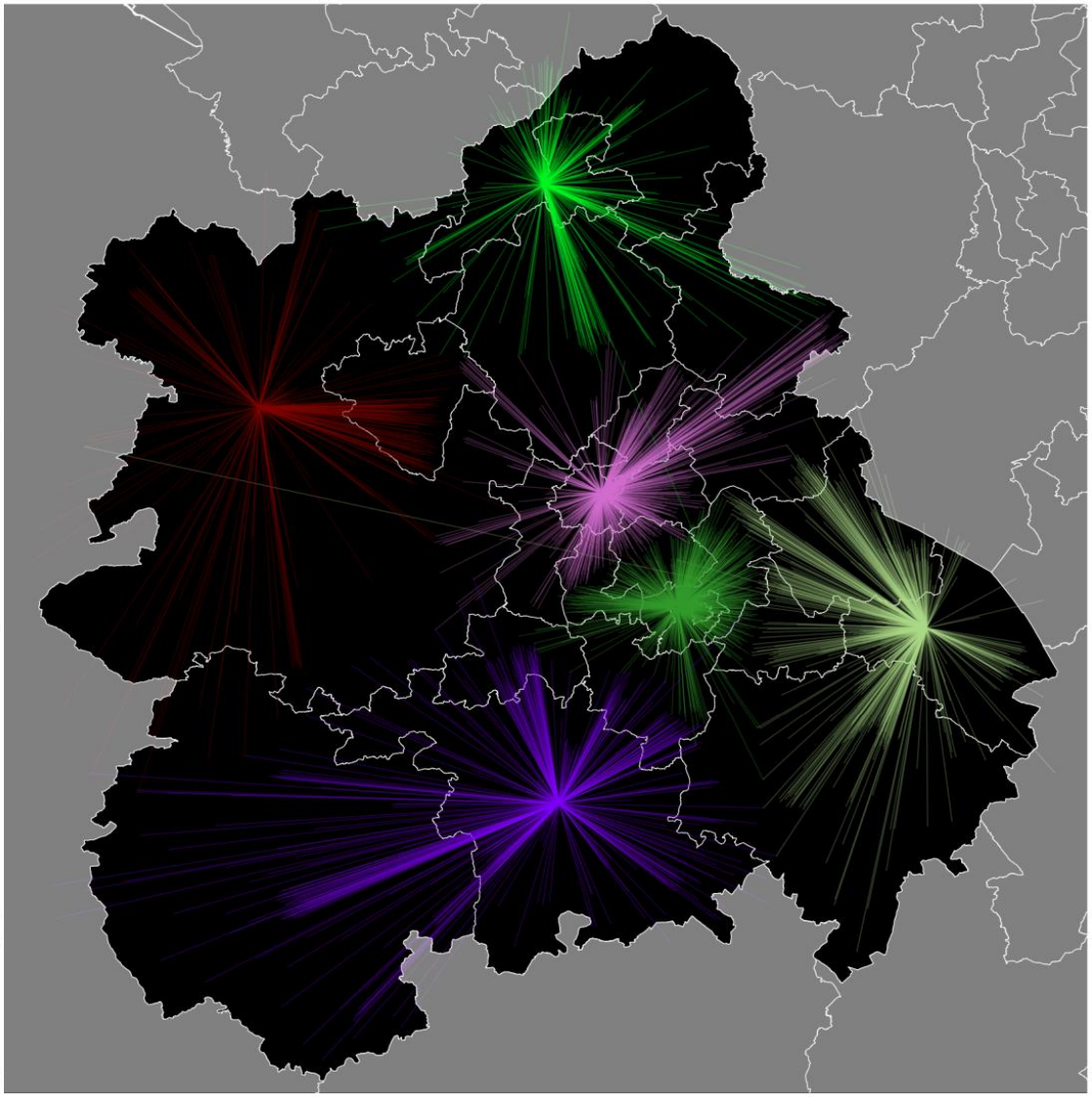
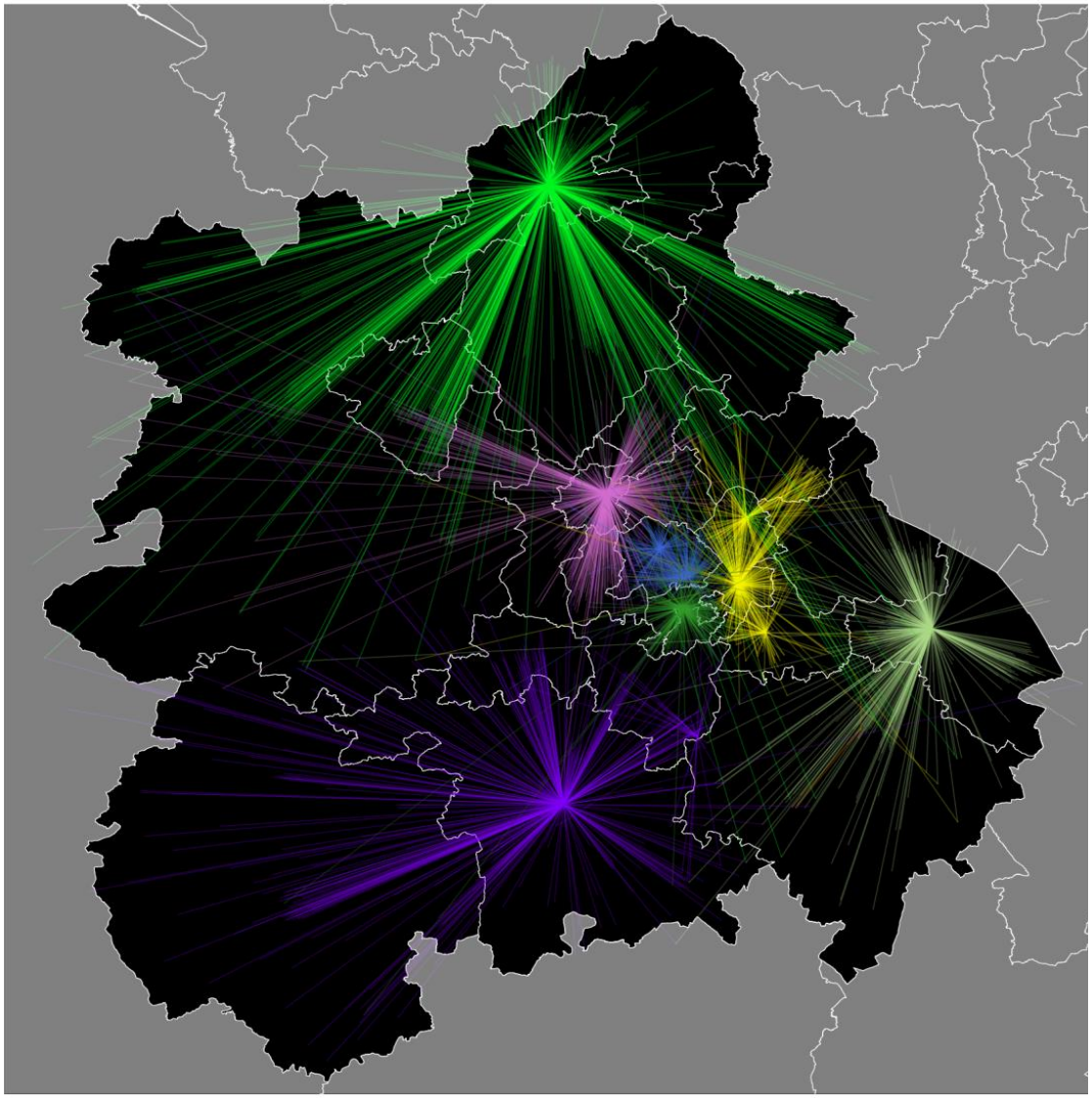


Appendix : Flow maps – PPCI

Baseline



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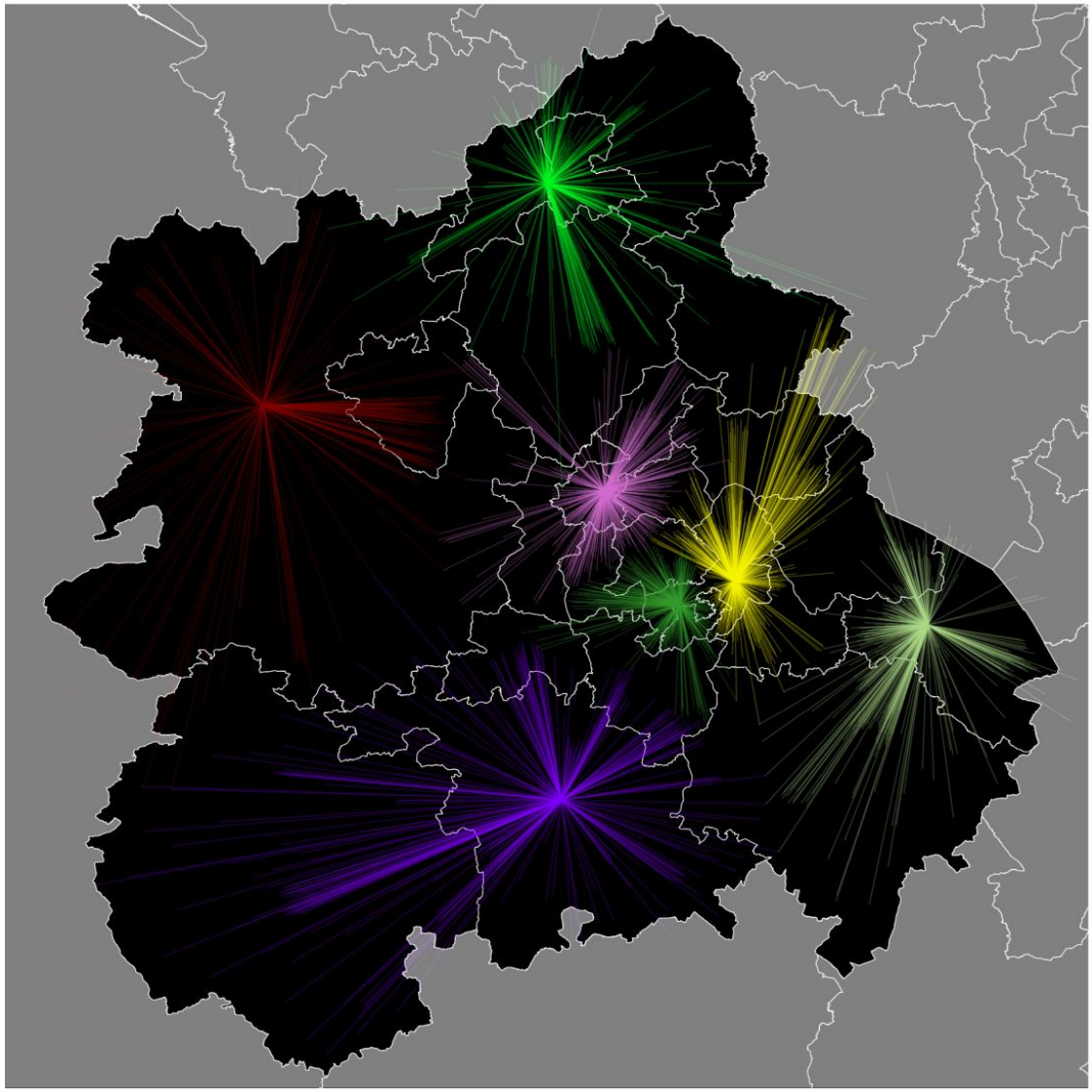
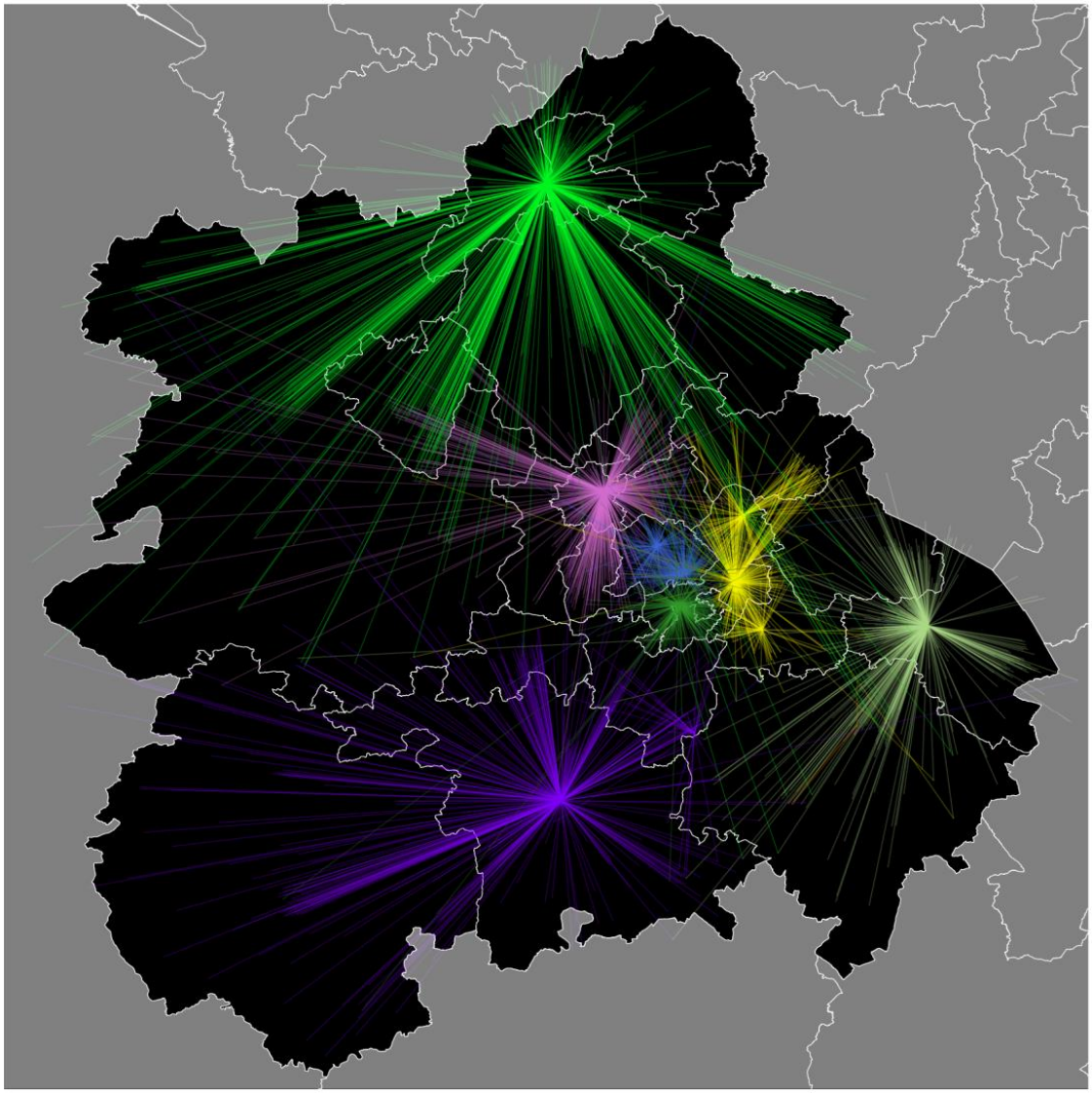


Appendix : Flow maps – PPCI

Baseline



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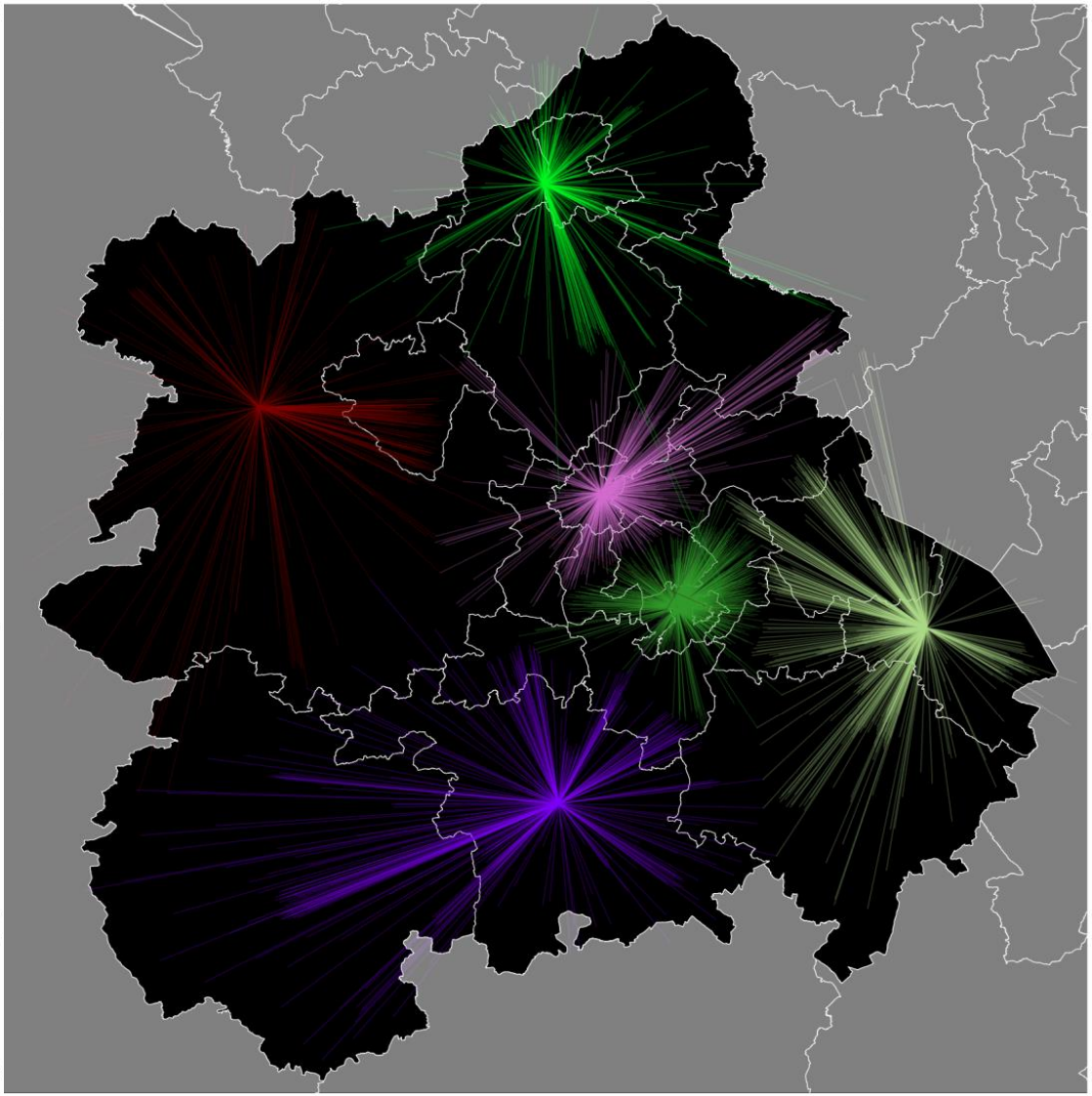
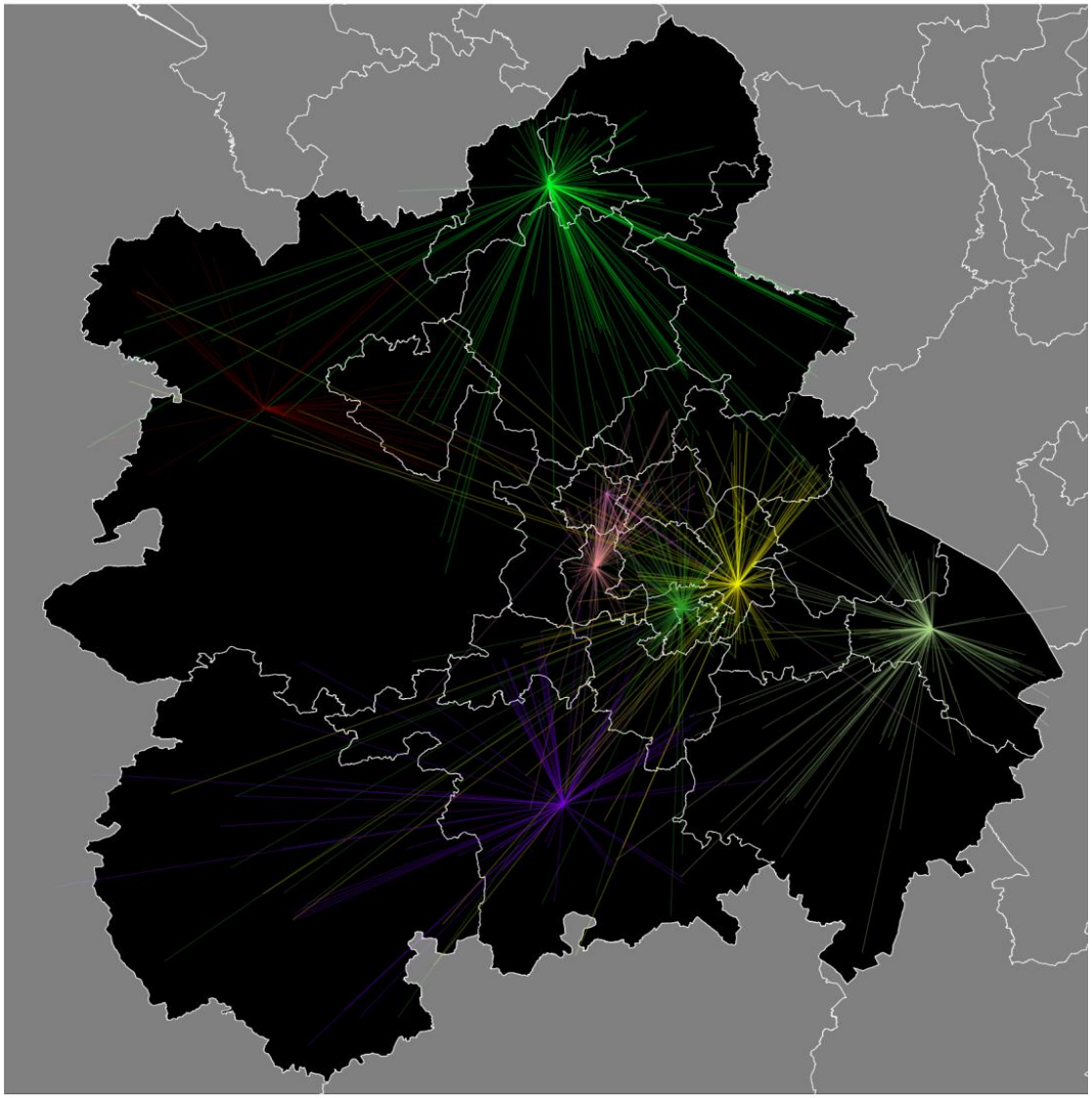
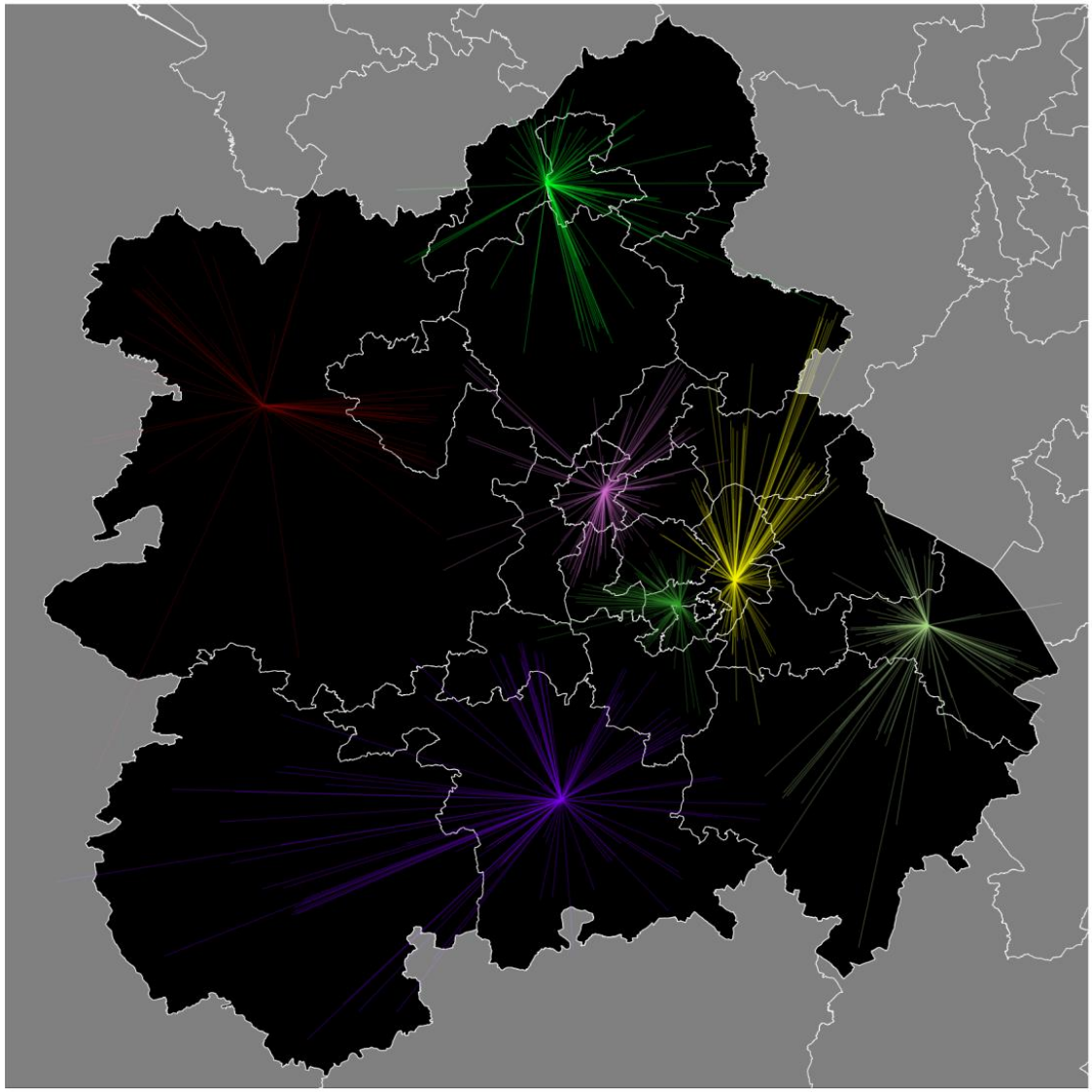


Appendix : Flow maps – Vascular Surgery

Baseline

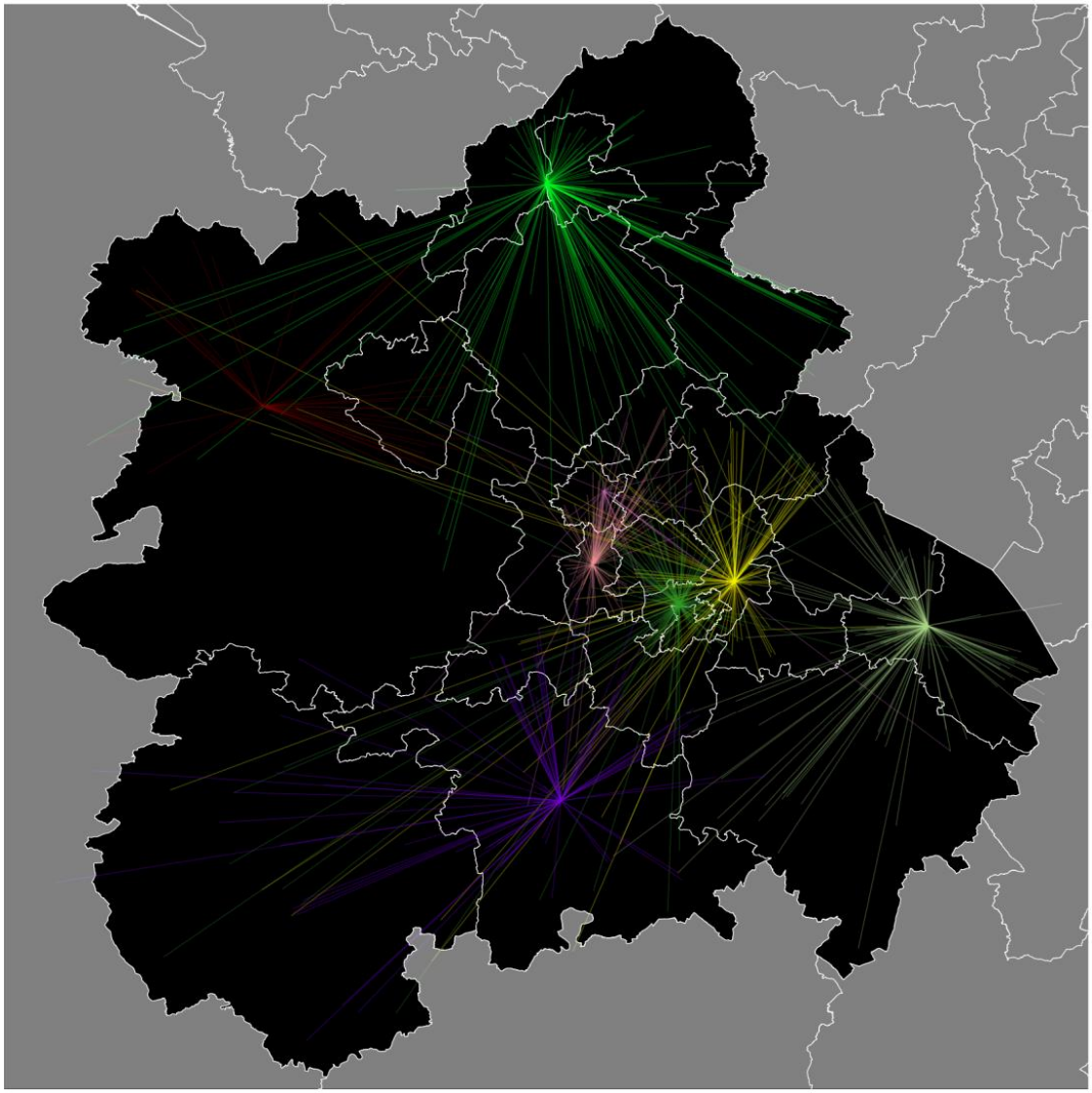


Configuration 1



Appendix : Flow maps – Vascular Surgery

Baseline



Configuration 2