Demand Analysis and Tactical Deployment of Ambulance Services in the National Ambulance Service Midlands Region

A report for the
Pre-Hospital Emergency Care
Council & the National
Ambulance Service

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Pre-Hospital
Emergency Care
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Table of Contents

1. Introduction and Background

This project was funded by the Pre-Hospital Emergency Care Council and co-ordinated by Dr Geoff King of the Pre-Hospital Emergency Care Council and Mr Frank McClintock Assistant National Director, National Hospital's Office.

The study builds on earlier work undertaken by the project team of Spatial Planning Solutions and Active Solutions (Europe) for the former National Ambulance Service Midlands region. These studies are the first of their kind in the Republic of Ireland in that it utilises detailed ambulance service records to firstly, assess both demand for and past performance of ambulance emergency care, and secondly, make recommendations on how the spatial configuration of services may be improved to achieve enhanced ambulance services in the region. Current and future trends are also examined.

The project has two parallel functions; firstly to provide recommendations on the spatial configuration of ambulance resources in the National Ambulance Service Midlands region from results of the demand and performance analysis of the ambulance service in the region; and secondly, to provide input into a template methodology that can be used throughout Ireland to assess ambulance service deployment options.

Project Aims

To achieve the above a set of project aims were developed, these are:

i) To analyse the spatial and temporal patterns of ambulance activity (emergency, urgent & patient transport) and make an assessment of emergency care demand for the National Ambulance Service Midlands region.

ii) To explore spatial options required to produce a Tactical Deployment Plan (TDP) that will improve response times for emergency patients.

iii) To communicate the optimum deployment plan and enable query by day or hour in relation to current configuration of services.

iv) To examine the sensitivity of the TDP in respect of current trends – taking into account population trends, development planning and road changes.

v) Consider the implications of ongoing changes in the demographic and development environment of the region and how these may affect future ambulance services.

Team Approach

The project has been undertaken by Spatial Planning Solutions (Cork) and Active Solutions (UK). Both companies have extensive experience in the analysis of Ambulance resources and developing plans for enhanced utilisation in Ireland, the United Kingdom and the USA.

In addition to progress meetings with the steering committee, an important aspect of this project was the valuable input and feedback from the ambulance staff of the region. Meetings open to all ambulance staff were held to gain their views on indicative findings and the study aims.

Study Period and Data Collection

Data for the study was supplied by the ambulance service of Midlands region and covers the period 1st January 2006 to 31st December 2006. This period was considered appropriate to allow a suitable overview of demand for ambulance services to generate the first generation of Tactical Deployment Plan for the region.

Data on emergency (AS1) and urgent (AS2) calls for the study period were generated automatically using the ambulance service's Command & Control system. Patient transport calls that required the use of ambulance resources were included. Other patient transport services that utilise taxi services are not captured digitally.

Report Structure

Detailed findings under various sections are set-out in sections 2 to 4. Section 2 and 3 examine spatial-temporal aspects of the ambulance records, emergency care demand and response performance for the area. In section 4 we set-out the methodology and findings of the 'Tactical Deployment Plan'. Section 5 examines future demographic and development growth in the region. The conclusions and a set of recommendations are provided in Section 6.

Acknowledgements

We would like to acknowledge the support of Dr Geoff King and the staff in the Pre-Hospital Emergency Care Council for their support in undertaking this project. Mr Frank McClintock, Assistant National Director of the National Hospitals Office who initiated this study. We would also like to thank Mr Robert Morton, Chief Ambulance Officer, National Ambulance Service Midlands region and his staff for their co-operation, valuable advice and support.

2. Emergency & Urgent Incident Demand Analysis

In this section we examine the demand profile of the emergency calls (AS1) and urgent calls (AS2) for the region during the study period. The demand analysis examines the temporal and spatial variation of demand for ambulance services for these types of incidents and also examines the call sources for the incidents. The results indicate where demand peaks are highest and how demand varies with location. The section provides a baseline for current activity and helps inform how future service delivery may be enhanced.

2.1 AS1 & AS2 Capture & Data Description

The records of AS1 and AS2 incidents were captured digitally within the computer-aided despatch system (CAD) used by the National Ambulance Service Midlands region. The ambulance service in this region operates a Medical Priority Despatch System (MPDS). The system operator creates a new record for an incident upon receipt of a call from either one of a variety of sources including the general public on the 999 call system, individual GPs or hospitals in the region. A unique incident identifier is recorded for each call and the name, address and type of incident are recorded by the operator. MPDS codes are given to AS1 incidents. The date and time of the call are automatically captured. For some incidents more than one resource (ambulance) may be assigned, thus generating multiple records for a single incident. For some incidents a resource may be assigned from a station at some distance from the incident, where resources are unavailable at a closer station. If resources become available at the closer station a resource is assigned from that station and the first resource may be stood down from the incident. Time stamps included in the records from the Midlands CAD record the following:

Table 2.1

Time stamps available in Computer System	
Time Stamp	**Description**
Creation Time	Time incident record created/registered on computer system
Assign Time	Time a resource (Ambulance) is assigned to an incident
Mobile Time	Time the resource leaves its station
On-Scene Time	Time of arrival at the incident location
Off-Scene Time	Time of departure from the incident location
At Hospital Time	Time of arrival at a hospital
Clear Time	Time resource is available to undertake another assignment

Incident Location;

The CAD system includes a mapping component that captures the national grid coordinate of an incident. The system indicates the locality of an incident using the address information provided by the operator. The suggested location is based on a 'look-up' database of localities in CAD which are derived from the OSI/An Post GeoDirectory and other mapping data such as townlands and villages and named road junctions. There are recognised shortfalls with the use of the GeoDirectory particularly in rural areas and under populated areas. The operator can select to assign the incident to the suggested location or establish the location 'by hand' through reading digital map displays. An assessment of the locational accuracy in the data audit of the data indicated minimal errors in data position and none that would materially affect the results of the study.

Incident Numbers;
The total number of AS1 and AS2 calls recorded was 13,394. A number of incidents were 'stood down' either before or after resources were assigned or sometimes after a resource had reached the location of an incident. In general all incidents where the ambulance(s) have reached the scene are considered in all aspects of the study and are identified in table 2.2 as 'unique responded incidents with location'; there were 7,617 AS1 and 5,003 AS2 such incidents in the Midlands region in 2006 (see table 2.2).

A number of incidents were explicitly 'stood down' by Control Room operators where they were either in progress to a scene or, for a small number, where an 'at scene' time is recorded but no location is provided. As these represent a use of ambulance service resources despite being 'stood down', the steering committee considered that such incidents should be included in the temporal and spatial analysis of demand but not in the Tactical Deployment Plan.

A small number of incident records included either no 'at scene' time or had no location information and the data base did not specify that these had been stood down. The numbers of such records are small, and upon close examination it is assumed that many of these records were never valid. Given the small number, in particular in respect to AS1 incidents and that most appear to be simply misreported[1] incidents, it is considered appropriate to exclude these records from the analysis, in the knowledge that this exclusion will not affect the overall results.

Table 2.2

Total Incident in Midlands Region				
Incident Type	**AS1**	**AS2**	**AS3**	**Total**
Unique Responded Incidents with Location	7,617	5,003	6,954	19,574
'Stood Down' before 'At Scene Time'	657	49	97	803
'Stood Down' unspecified Location		4		4
No 'At Scene' time	-	-	-	-
Unspecified Location	47	17	1	65
Number of Incidents	**8,321**	**5,073**	**7,052**	**20,446**

MPDS
A Medical Priority Despatch System (MPDS) is deployed in the midlands region. An analysis of the respective categories of calls was carried out to assess the systems efficacy in identifying life threatening calls and the impact on the Tactical Deployment Plan when these are used. This is presented in section 4.6 of the report.

2.2 Temporal Variability

The demand profile for AS1 and AS2 calls received in the Midlands region is examined by month, day of the week, and by hour of the day.

2.2.1 Monthly Variation

The incident call rate for AS1 and AS2 calls for the study period are listed below in table 2.3, average monthly rates and average daily rates per month are also calculated.

[1] This term is used to refer to records that could be either 'test' records, or errors during a recording that remained stored in the CAD system. They are included here to ensure the number of records stored in the CAD system, and those used in the study, tally.

Table 2.3

Average Monthly Variation (All Incidents)						
Month	AS1	AS2	Total AS1 & AS2	Per Day		
				AS1	AS2	Total
January	635	459	1,094	20	15	35
February	596	429	1,025	21	15	37
March	716	460	1,176	23	15	38
April	659	426	1,085	22	14	36
May	681	457	1,138	22	15	37
June	717	402	1,119	24	13	37
July	766	338	1,104	25	11	36
August	691	388	1,079	22	13	35
September	696	415	1,111	23	14	37
October	697	422	1,119	22	14	36
November	634	440	1,074	21	15	36
December	833	437	1,270	27	14	41
Total	**8,321**	**5,073**	**13,394**	**23**	**14**	**37**
Average Monthly	***693***	***423***	***1,116***			

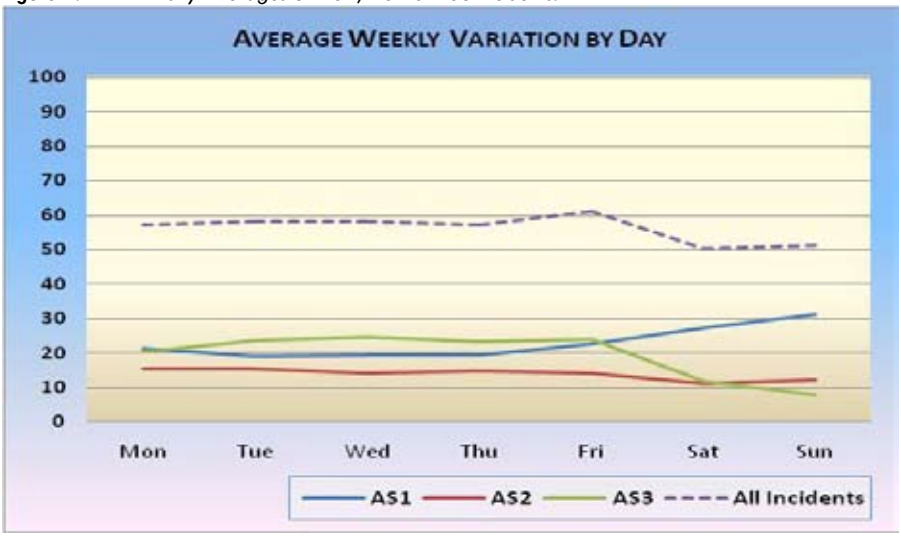
Within the region the average monthly rate for AS1 incidents was 693 and 423 for AS2 incidents. December had the highest numbers of incidents of any individual month; December also has the highest daily average of any month for AS1 calls with a daily average of 27. This is higher than the annual daily average of 23 AS1 calls per day, although not as significant as other regions. Within the December figures, highest rates of AS1 calls occurred over the Christmas period which began in 2006 around Friday the 22nd of December.

2.2.2 Weekly Variation

Incident rates across the week in the midlands are broadly static during week days but show a distinct increase in AS1 activity at the weekends. In contrast a strong reduction in demand for AS3 services and smaller reduction in AS2 activity during the weekends (see figure 2.1).

The busiest day is Friday; this is mainly due to growing levels of AS1 associated with weekend activities corresponding to sustained levels of AS3 activity. The continued AS3 activity is likely to relate to 'decanting' of patients from hospitals before the weekends.

Figure 2.1 *Daily Averages of AS1, AS2 & AS3 incidents.*



2.2.3 Daily Variation

When taken together across all days of the week the average hourly rate of AS1 incidents in the Midlands is relatively stable at generally around 0.9 incidents per hour, the exception to this in the very early morning between 03.00hrs and 07.00hrs when demand reduces to below one incident per two hours. In contrast AS3 demand is almost exclusively only required during the day. Call rates for AS3 show a marked drop between 12.00hrs and 14.00hrs (lunch time) and pick up again until 16.00hrs after which rates begin to reduce rapidly. AS2 demand is also concentrated during the day, however there is no apparent demand reduction over lunch times, and the evening reduction is significantly less marked than that of AS3 calls (see figure 2.2 below).

Figure 2.2 *Average number of incidents per hour (all days of week)*

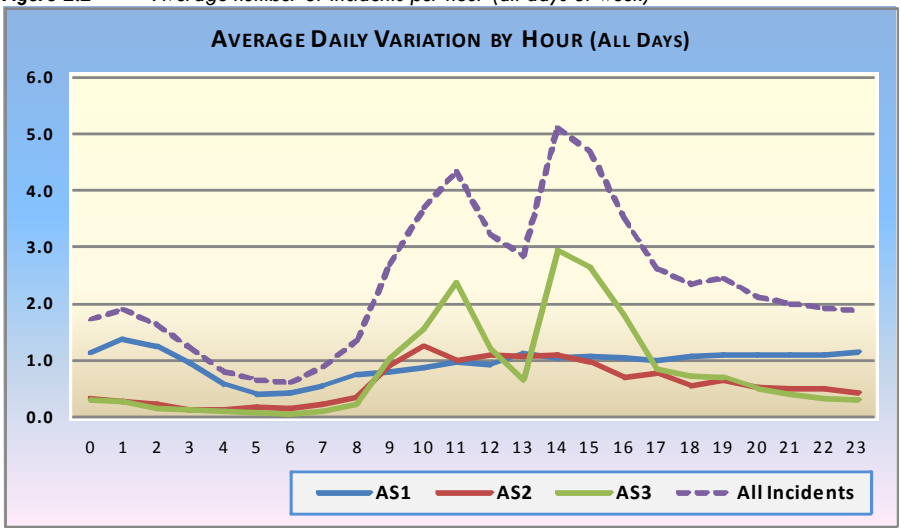


Table 2.4

Average Daily Variation by Hour (All Days)				
Hour	AS1	AS2	AS3	All Incidents
Average Hourly	***0.95***	***0.6***	***0.8***	***2.3***
Ave. 08.00 to 18.00	*0.97*	*0.9*	*1.4*	*3.3*
Ave. 19.00 to 07.00	*0.93*	*0.3*	*0.3*	*1.5*

As already noted there are different incident rates during weekend hours compared to weekdays, for this reason figure 2.3, and 2.4 examine incident rates for hours during the weekend and weekdays[2] respectively.

Figure 2.3 *Average number of incidents per hour (weekend only)*

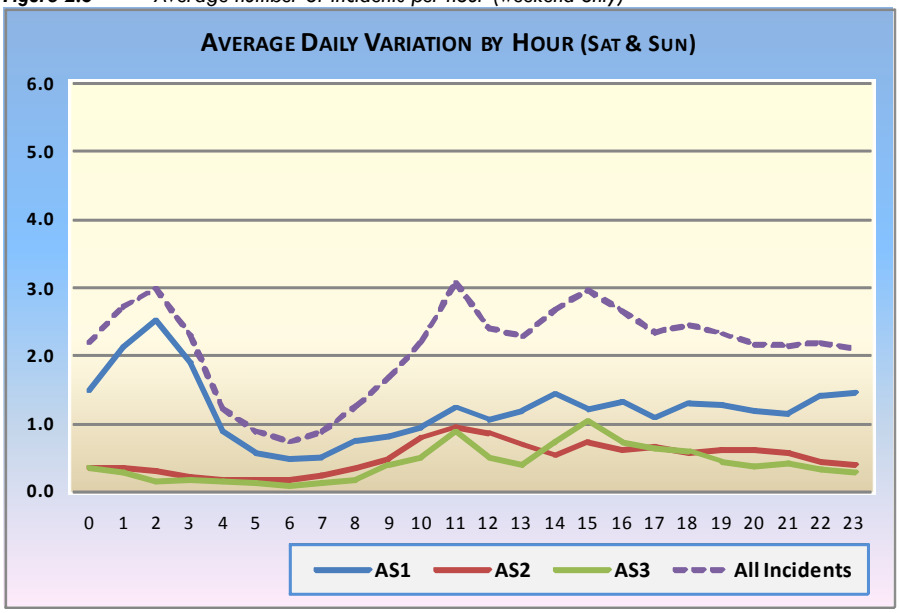


Table 2.5

Average Daily Variation by Hour (Sat & Sun)				
Hour	AS1	AS2	AS3	All Incidents
Total Daily Average	**29**	**12**	**10**	**51**
Average Hourly	***1.2***	***0.5***	***0.4***	***2.1***
Ave. 08.00 to 18.00	*1.1*	*0.6*	*0.6*	*2.4*
Ave. 19.00 to 07.00	*1.3*	*0.4*	*0.3*	*1.9*

[2] Excludes Monday incidents which are skewed from remaining AS1 activity in the early hours of Monday morning

Figure 2.4 *Average number of incidents per hour (weekdays only)*

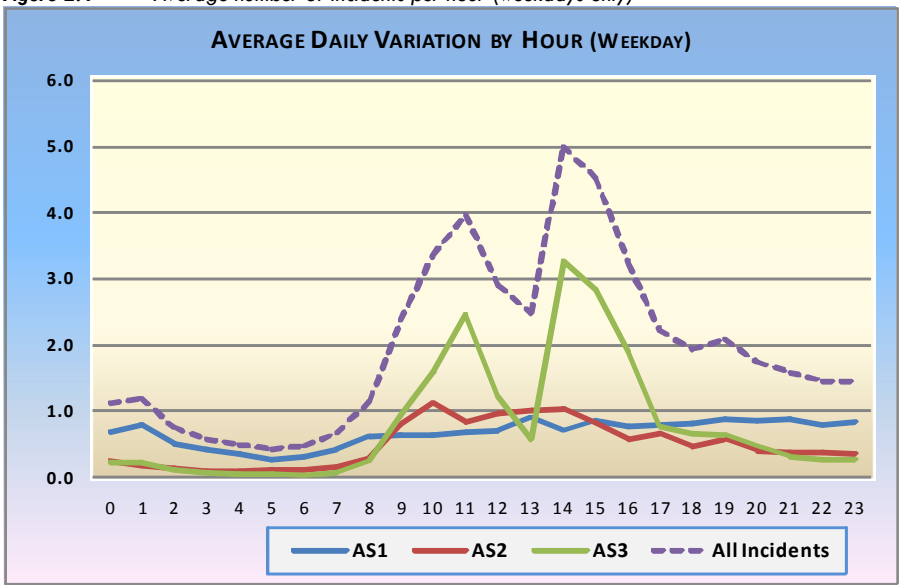


Table 2.6

Average Daily Variation by Hour (Weekday)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Total Daily Average	**16**	**12**	**19**	**47**
Average Hourly	***0.7***	***0.5***	***0.8***	***2.0***
Ave. 08.00 to 18.00	*0.7*	*0.8*	*1.5*	*3.0*
Ave. 19.00 to 07.00	*0.6*	*0.2*	*0.2*	*1.1*

At weekends demand on ambulance services from AS1 activity increases while there is a corresponding decrease in AS2 and AS3 demand. The average hourly demand at the weekend is 1.2 AS1 incidents per hour compared to the 0.7 per hour for weekdays only. The average hourly rate of AS3 on Saturdays and Sundays is 0.4 compared to 0.8 per hour for weekdays (see tables 2.5 and 2.6).

The period 23.00hrs to 04.00hrs on weekend nights and the early hours of Mondays (see figure 2.3) are the busiest times for AS1 activity with call rates approaching an average of 2.5 per hour at around 02.00hrs. Day time demand for AS1 services is broadly similar to weekday activity.

2.2.4 AS3 Temporal Variability

AS3 calls make up around 34% of the numbers of incidents recorded in the Midlands region. Monthly variation of AS3 demand remains stable throughout the year with a monthly average of 588 calls, the busiest month was September, however no particularly strong pattern of demand emerges.

Per day an average of 19.3 incidents occurs (see table 2.7), however figures 2.3 and 2.4 highlight the fact that AS3 activity principally occurs during weekdays and is concentrated into the hours 09:00hrs to 13:00hrs and 14:00hrs to 17:00hrs. For all AS3 incidents 85% of them are required during weekdays (6036) and of this 73.4% of those incidents (4,429) occur between the hours listed above. Thus during weekdays (Mon – Fri) a daily average of 23 AS3 incidents occurs between 09:00hrs to12:59hrs and 14:00hrs to 16.59hrs.

The records of the Midlands Ambulance Service indicate that all AS3 PTS activity was undertaken by emergency ambulances. The impact of this activity on resource availability is assessed in later sections.

Table 2.7 AS3 Monthly variation

Average Monthly Variation (AS3 Incidents)			
Month	**AS3**	**% of All Incidents**	**Average AS3 Per Day**
January	578	35%	18.6
February	540	35%	19.3
March	611	34%	19.7
April	543	33%	18.1
May	618	35%	19.9
June	600	35%	20.0
July	608	36%	19.6
August	620	36%	20.0
September	648	37%	21.6
October	523	32%	16.9
November	601	36%	20.0
December	562	31%	18.1
Total	**7,052**	**34%**	**19.3**
Average Monthly	***588***		

2.2.5 Temporal Variation Findings

A number of salient features emerge from the tables and graphs and tables of temporal demand, these are;

- There is only minor variation on the monthly rates of incidents during the study period, while there was little discernable difference between summer and winter rates, December rates for all incidents did increase, especially for AS1 incidents, this was offset by lower rates during January.

- Significant variation of demand activity occurred between weekends and weekdays. The weekly profile of demand demonstrated that AS1 calls increased over weekends, but rates of AS2 and AS3 incidents reduced, especially in the case of AS3 call activity. On weekdays AS2 and AS3 calls showed relatively small changes in activity.

- During the day two demand peaks are apparent on weekdays, firstly between 11.00hrs to 12.00hrs and particularly between 14.00hrs to 15.00hrs, this is primarily driven by

AS3 call activity, which drops to very low levels at 13.00hrs (lunchtime). Call rates for AS1 and AS2 incidents do not display any particular change at this time however.

- At weekends the highest levels of activity occurred between 00.00hrs and 04.00hrs with AS1 calls dominating the demand profile and a peak in activity at 01.00hrs.

- AS3 activity is concentrated into the hours 09:00hrs to 17:00hrs on weekdays. AS3 calls are primarily undertaken by emergency ambulances.

2.3 Spatial Analysis of Incidents

The spatial analysis sets out to examine patterns of demand across the region. While the impact of demand on resources is examined in later sections of the report, this section provides a framework for how different demands occur between urban and rural locations in the region.

The variability in time and space is assessed initially for AS1 and AS2 incidents. In later sections the AS3 incidents are examined.

2.3.1 Analysis Framework

To assess the spatial distribution of demand for emergency care a spatial typology was developed. This was based on the following criteria:

- Main urban centres (towns greater than 5,000 persons) consisting of:
  Athlone Mullingar Tullamore Edenderry
  Longford Portlaoise Portarlington
- Towns with population in 2006 of over 1,000 persons *(these towns have full listing of census variables in the CSO Small Area Population Statistics for the region)*
- Rural areas (population density greater than 10 persons per Km^2)
- Sparsely populated areas (population density of less than 10 Persons per Km^2).

Figure 2.5 *Settlements and current distribution of ambulance stations*

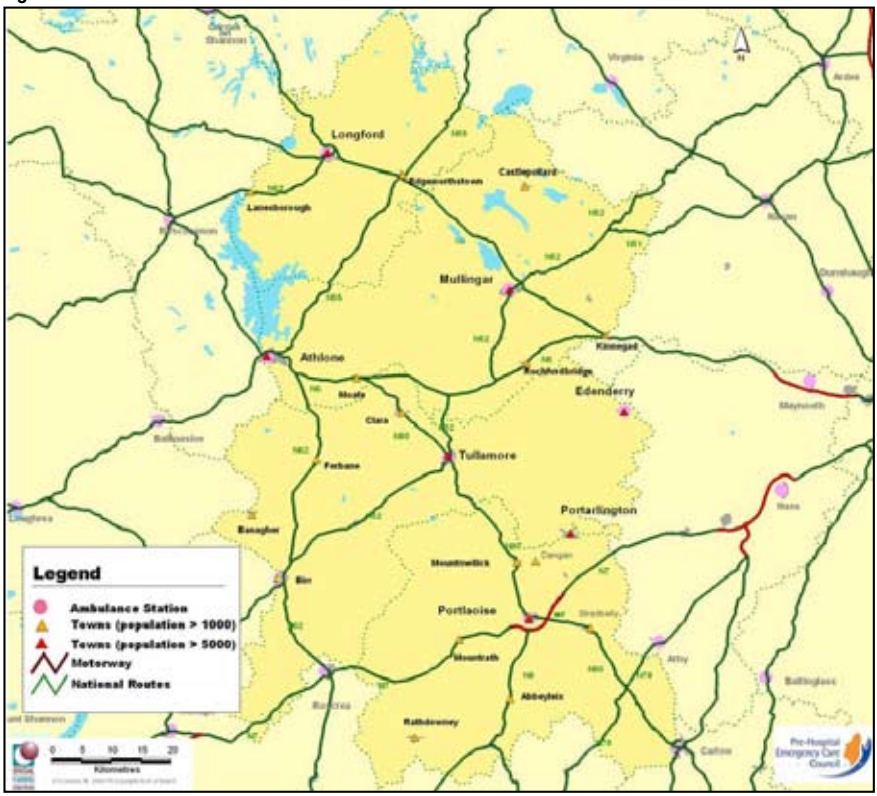
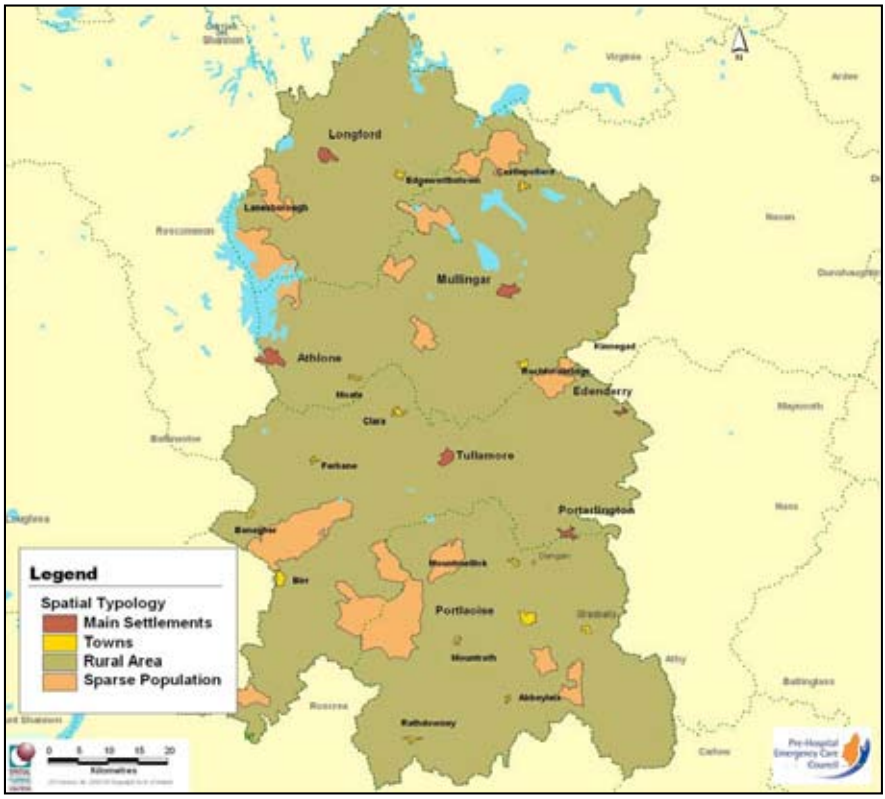


Figure 2.6 *Spatial Typology*



Source: SABE Eurogeographics, OSI and Spatial Planning Solutions Ltd.

In population terms the most current census in 2006 indicated that the entire region had a population of 251,664 persons. From 2002 to 2006 the population of the region increased by 11.7% (see table 2.8), which is above the national average of 8%. Population growth was strongest in the towns with an increase of 21.1% compared to rural areas with an increase of around 6.9%. Westmeath towns had very strong growth where an increase of 23.7% represented an increase of 5,726 people in the four year period. The strengthening of the urban population base in the region corresponds to national trends and has important implications for future emergency care provision.

2.3.2 Spatial Distribution of Incidents (AS1 & AS2)

Using the geo-codes of incident location the incidents in the study period were mapped against the rural typology and linked to Census units, Electoral Divisions (EDs), in the region. The results of this exercise are presented below in table 2.8 which provides aggregations of each category of the area typology by county for AS1 and AS2 incidents.

Table 2.8 *Incidents (AS1 & AS2) within spatial typology*

Name	Total Population		% Change	No. Incidents (AS1 & AS2)	AS1 & AS2 Incidents per 100 persons	AS1 incidents per 100 persons
	2002	2006				
Laois						
Towns & Villages	21,268	25,009	17.6%	1,302	5.2	3.1
Rural Areas	36,626	41,075	12.1%	1,367	3.3	2.1
Low Density Rural Area	880	975	10.8%	14	1.4	0.8
Total	58,774	67,059	14.1%	2,683	4.0	2.5
Longford						
Towns & Villages	8,500	9,955	17.1%	1,397	14.0	7.4
Rural Areas	21,833	23,685	8.5%	1,084	4.6	2.7
Low Density Rural Area	735	751	2.2%	33	4.4	2.1
Total	31,068	34,391	10.7%	2,514	7.3	4.0
Offaly						
Towns & Villages	28,520	34,989	22.7%	1,603	4.6	3.0
Rural Areas	34,199	34,907	2.1%	1,387	4.0	2.6
Low Density Rural Area	944	972	3.0%	44	4.5	3.0
Total	63,663	70,868	11.3%	3,034	4.3	2.8
Westmeath						
Towns & Villages	24,171	29,897	23.7%	2,698	9.0	5.9
Rural Areas	49,162	47,962	-2.4%	1,960	4.1	2.5
Low Density Rural Area	1,425	1,487	4.4%	33	2.2	1.3
Total	71,858	79,346	10.4%	4,691	5.9	3.8
Midlands region						
Towns & Villages	**82,459**	**99,850**	**21.1%**	**7,000**	**7.0**	**4.3**
Rural Areas	**152,289**	**162,734**	**6.9%**	**5,798**	**3.6**	**2.2**
Low Density Rural Area	**3,984**	**4,185**	**5.0%**	**77**	**1.8**	**1.7**
Total	**225,363**	**251,664**	**11.7%**	**12,875**	**5.1**	**3.2**

Sources*: CSO 2006 & Midlands Ambulance Service*

The results indicate average rates of incidents per head on population, where for the region as a whole there were 5.1 incidents per 100 persons, this is made up of 3.2 AS1 incidents per 100 persons with the residual, 1.9, being the number of AS2 incidents per 100 persons.

The key feature from this analysis is that rates of AS1 and AS2 per capita are significantly higher in urban areas compared to rural areas. Thus for example there were 7.4 AS1 incidents per 100 persons in Longford towns compared with 2.7 per 100 persons in rural areas. An additional feature of the results is that in sparsely populated areas rates of incidents are lower than other rural areas.

In respect to urban/rural difference in incident rates, it is difficult to be definitive about the causes, especially since information on incident type does not indicate levels of severity of a particular incident. Possible reasons for the higher propensity of urban population to avail of ambulance services is likely to be related to a variety of factors such as the location of activities that generate higher demand for emergency services, for example nightclubs or nursing homes, or the perception that emergency care is only used as a last resort in rural areas whereas in urban areas people may be prepared to call the ambulance service earlier.

Although the absence of robust information on incident type limits deeper understanding of this aspect of demand within the context of this study, the fundamental feature of the analysis is that demand for emergency care services is not simply related to per-capita distribution of population in the region but also to its location vis-à-vis urban and rural locations. Thus as urban population increases, demand for emergency care will increase at higher rates than the per-capita increase in population.

Table 2.9 lists the populations and incident rates for all urban areas (towns greater than 1,000 persons in 2006). The table also highlights main settlements where population is greater than 5,000 persons. The towns of Offaly and Westmeath show strong population increases. This is considered to be related to the increased commuting area around Dublin City, where road improvement and housing costs in the greater Dublin region have contributed to the enlargement of the employment catchment of the city.

There is considerable variation in the levels of incidents that were responded to by the National Ambulance Service Midlands region. Established large towns such as Longford, Tullamore and Mullingar had rates between 4.9 to 8.6 AS1 incidents per 100 persons, while other large towns, notably Portlaoise had significantly lower rates. The rapidly growing towns within Dublin's extended commuter belt had lower than average incident rates; this is likely to reflect their younger population profile.

Table 2.9 *Urban Population and AS1 & AS2 incident rates in Midlands region*

Name	Persons 2002	Persons 2006	% Change	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Laois Towns							
Abbeyleix	1,383	1,568	11.8%	80	5.1	28	1.8
Dangan	777	1,056	26.4%	1	0.1	1	0.1
Mountmellick	3,361	4,069	17.4%	296	7.3	110	2.7
Mountrath	1,331	1,435	7.2%	73	5.1	47	3.3
Portlaoise	12,127	14,613	17.0%	507	3.5	367	2.5
Rathdowney	1,111	1,212	8.3%	54	4.5	39	3.2
Stradbally	1,178	1,056	-11.6%	70	6.6	44	4.2
Total Laois	**21,268**	**25,009**	15.0%	**1,081**	**4.3**	**636**	**2.5**
Longford Towns							
Edgeworthstown	726	1,221	40.5%	161	13.2	54	4.4
Lanesborough	943	1,112	15.2%	42	3.8	29	2.6
Longford	6,831	7,622	10.4%	1,194	15.7	652	8.6
Total Longford	**8,500**	**9,955**	14.6%	**1,397**	**14.0**	**735**	**7.4**

continued over

Table 2.9 cont

Name	Persons 2002	Persons 2006	% Change	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Offaly Towns							
Banagher	1,789	1,950	8.3%	45	2.3	16	0.8
Birr	3,590	4,091	12.2%	320	7.8	74	1.8
Clara	2,704	3,001	9.9%	165	5.5	127	4.2
Edenderry	4,216	5,617	24.9%	259	4.6	153	2.7
Ferbane	1,122	1,170	4.1%	26	2.2	18	1.5
Portarlington	4,001	6,233	35.8%	265	4.3	166	2.7
Tullamore	11,098	12,927	14.1%	744	5.8	635	4.9
Total Offaly	**28,520**	**34,989**	18.5%	**1,603**	**4.6**	**1,049**	**3.0**
Westmeath Towns							
Athlone	10,254	14,347	28.5%	1,347	9.4	818	5.7
Castlepollard	895	1,004	10.9%	84	8.4	24	2.4
Kinnegad	1,296	2,245	42.3%	89	4.0	73	3.3
Moate	1,520	1,888	19.5%	170	9.0	67	3.5
Mullingar	8,824	8,940	1.3%	949	10.6	730	8.2
Rochfortbridge	1,382	1,473	6.2%	58	3.9	44	3.0
Total Westmeath	**24,171**	**29,897**	19.2%	**2,697**	**9.0**	**1,756**	**5.9**
Urban Total	**82,459**	**99,850**	17.4%	**6,999**	**7.0**	**4,316**	**4.3**

Note: *See table 2.6 for rural population*

2.3.3 Spatial Distribution of Incidents (AS3)

AS3 ambulance activity concerns Patient Transport Services (PTS) and is considered to be non-urgent, routine patient services that use ambulance resources, mini-bus and local taxi services. Choice of service is based on patient needs and availability of resources. Control Room staff makes decisions on appropriate allocation of resources using locally adopted Standard Operating Procedures. Under these circumstances there exists considerable variability in the 'pick-up' location of patients and where they are taken to. The 'pick-up' location may be a patient's home, a nursing home, or a hospital. 'Pick-up' locations often cluster around hospitals where onward transport to another hospital in the region occurs or from a major hospital onward to specialist centres, usually in Dublin. The National Ambulance Service Midlands region records incidents where ambulance resources are used. The system records the 'pick-up' location as a national grid coordinate, it also records the hospital/clinic attended by the patient and the final destination of the patient, which may be their home, a nursing home or a hospital.

The spatial distribution of 'pick-up' points in respect to the study spatial typology reflects the operational and secondary care environment in the Midlands region. Thus the Midlands Regional Hospital in Tullamore as the principal hospital for the region attracts a considerable proportion of inward and outward AS3 activity (see table 2.10). Despite this bias of AS3 activity, centred on locations with major hospitals, there remains a propensity for AS3 activity to be urban based.

Table 2.10 *Spatial Typology and AS3 incident rates in the Midlands region*

Name	No. AS3 Incidents	AS3 Incidents per 100 persons
Laois		
Towns & Villages	1,945	7.8
Rural Areas	54	0.1
Low Density Rural Area	2	0.2
Total	2,001	3.0
Longford		
Towns & Villages	132	1.3
Rural Areas	27	0.1
Low Density Rural Area	2	0.3
Total	161	0.5
Offaly		
Towns & Villages	2,361	6.7
Rural Areas	77	0.2
Low Density Rural Area	4	0.4
Total	2,442	3.4
Westmeath		
Towns & Villages	1,904	6.4
Rural Areas	94	0.2
Low Density Rural Area	2	0.1
Total	2,000	2.5
Midlands region		
Towns & Villages	**6,342**	**6.4**
Rural Areas	**252**	**0.2**
Low Density Rural Area	**10**	**0.2**
Total	**6,604**	**2.6**

Table 2.11 below provides a matrix of 'pick-up' locations by town against the hospitals where patients were taken. This indicates the highest patient movement occurred from Tullamore, with the majority of movement from there to the Portlaoise Hospital. The next highest number of patient movements occurred from Portlaoise, with Tullamore Hospital being the principal destination. Thus the majority of AS3 activity concerns inter-hospital transport between these hospitals. The Crumlin Children's Hospital and St. James' were the principal 'out-of-region' hospitals attended.

Of the total number of AS3 incidents (6,134) 3,945 were movements within the region where the pick-up and hospital attended were within the region. In total 720 AS3 incidents were to hospitals or clinics in Dublin, with a small number of movements to other out-of-region hospitals.

Table 2.11 *Pick-up Location and Hospital Attended AS3 incidents*

Hospital Attended (To)	Pick-up Location (From)					
	Tullamore	Portlaoise	Mullingar	Longford	Athlone	Total
Tullamore Regional Hospital	8	1,118	605	14	61	1,806
Portlaoise Regional Hospital	887	25	5			917
Mullingar Regional Hospital	353	7	17	25	7	409
St Joseph's Longford	31		119	63		213
St Vincent's Mountmellick	24	144				168
Crumlin Children's Hospital	19	81	52			152
St James' Hospital, Dublin	67	49	30		1	147
St Mary's Hospital, Mullingar	25		78			103
Beaumont Hospital, Dublin	28	25	30			83
St Loman's, Mullingar	10		64	1	1	76
Mater Hospital, Dublin	31	8	35		1	75
Athlone District Hospital	61		5		7	73
Birr Community Nursing Unit	50	1				51
Shaen Hsp. (St Brigit's) Laois	11	40				51
Tallaght Hospital, Dublin	20	12	15		3	50
Temple Street Hospital, Dublin	3	21	22			46
Abbeyleix District Hospital	7	37				44
St Fintan's Hospital, Portlaoise	17	17				34
Eye & Ear, Dublin	11	6	11	1		29
Portiuncula Hospital, B/Sloe	8	1	3		14	26
Coombe Maternity Hospital		10	14			24
St Vincent's, Elm Park	9	6	8			23
Holles St Hospital		7	10			17
St Luke's Hospital, Kilkenny	9	3				12
St Luke's Hospital, Dublin	7		3	2		12
Mater Private Hospital, Dublin	1	3	6			10
University Hospital Galway	3	5	1		1	10
Rotunda Maternity Hos., Dublin		4	5			9
Waterford Regional Hospital	1	3				4
Limerick Regional Hospital		3				3
Naas General Hospital	1	2				3
St Vincent's, Athy	1	2				3
Blackrock Clinic, Dublin		2				2
Cavan Hospital			2			2
Our Lady of Lourdes			2			2
Rehab, Dun Laoghaire	1				1	2
Aut Even Hospital, Kilkenny		1				1
Connolly Hospital, B/Town			1			1
Cork Regional Hospital		1				1
Merlin Park, Galway					1	1
Sligo General Hospital	1					1
St Patrick's Hospital		1				1
Not Specified	*592*	*193*	*618*	*13*	*21*	*1,437*
Total	**2,297**	**1,838**	**1,761**	**119**	**119**	**6,134**

A number of key features emerge from the spatial distribution of PTS activity levels across the respective base stations, these are:

- That patient transport services are dominated by transport from inter-hospital transport between Tullamore and Portlaoise.
- Portlaoise Town has the highest number of incidents relative to resident population and the second highest total volume of AS3 incidents in the region.
- Trips for patients attending Dublin hospitals represent around 11% of the total volume of AS3 activity.

3. Performance Analysis

3.1 Performance Standards

The Pre-Hospital Emergency Care Council is actively reviewing appropriate performance measurement standards for the Republic of Ireland. Response time has been the traditional performance indicator of ambulance service performance in many jurisdictions. In the past the use of response targets were criticised due to lack of clinical context. Priority dispatch procedures and closer linking of response targets to clinical outcomes have ensured that examination of response time continues to be the most frequently used indicator of performance. In this section we provide an overview of response time results of the ambulance service in the Midlands region, in later sections we make recommendations on improving these.

Response time is recognised as the time it takes for an ambulance to reach the scene of an emergency incident from receipt of a call. The definition when to start and stop the clock has varied in different jurisdictions. There is a consensus developing that the start time for assessing response time should be based on the time that an emergency call is received (call receipt). In the UK the KA34 data standard for ambulance services defines this start time as the time whereby details of the callers telephone number, the exact location of the incident and nature of chief complaint is ascertained. In this section of the study we assess performance of response time as the elapsed time from this start time to arrival of the first resource to a scene.

A second consideration of the use of response time is what are appropriate response times for particular incidents and to particular locations? In the United Kingdom the Health and Social Care Standards and Planning Framework (2005/06–2007/08), published by the Department of Health redefines the original 1974 ORCON standards by targets based on Category 'A' incidents and Category 'B' incidents. Category 'A' incidents clinically defined as "immediately life threatening" and Category 'B' encompasses incidents that are clinically defined as "not life threatening but still serious". Based on this division the following response targets have been put forward for all ambulance trusts.

- Respond to 75% of 'Cat A' calls within **eight minutes**
- Respond to 95% of 'Cat A' calls within **14 minutes** (urban) and **19 minutes** (rural)
- Respond to 95% of 'Cat B' calls within **14 minutes** (urban) and **19 minutes** (rural)

(From Health and Social Care Standards and Planning Framework (2005/06–2007/08, Appendix 1, page 35)

Urban areas are defined as areas where population is greater than 100 persons per Km^2 (2.5 persons per acre) and rural areas where population density is less than 100 persons per Km^2. In Scotland three spatial definitions are used, high density (more than 120 persons per Km^2), medium density (less than 120 per Km^2 but more than 20 persons per Km^2) and sparse density (less than 20 per Km^2).

Ireland's settlement structure and urban hierarchy is significantly different to the UK and direct translation of these definitions of urban and rural locations may not be appropriate. In the case of the Midlands 53% of the area has a population density of less 20 persons per Km^2 and contains 19% of the total resident population. Equally while there are some strong urban settlements, in general the urban structure is weak and the population is dispersed. Furthermore the distinction between Category 'A' and Category 'B' calls are not equivalent to the distinction

between 'AS1' and 'AS2' incidents in the Irish context. Direct comparison of the results of the performance analysis presented here with other jurisdictions is therefore not yet fully feasible.

In section 2.3.2 we put forward a spatial typology based on census definitions of towns, and population density from the 2006 census. This typology usefully captures the fundamental settlement patterns of the Midlands region and provides a finer grain of analysis than the UK and one more relevant to an Irish context. The use of response time targets as reflected in the spatial typology is intended therefore to provide an initial overview of performance. It is hoped that this will establish a baseline for interventions aiming to enhance the ambulance service performance and that will move toward achieving a response target of eight minute response time for greater than 50% of 'life threatening' AS1 incidents.

3.2 Response Times in the Midlands region

The average (median) response time for the study period for the entire Midlands was 18.6 minutes for all AS1 & AS2 incidents combined. For AS1 the median response time for all incidents was 13.5 minutes and 27.4 minutes for AS2 incidents. The percentage incidents responded to within certain time bands provides a better means of examining response targets and these are presented below.

3.2.1 Response Time

For the entire region 23.3% of AS1 incidents are responded to in under eight minutes and 16% of AS2 incidents. In the main settlements this rises to 42% of all AS1 incidents (25% AS2) whereas in rural locations 9% of AS1 calls were responded to in eight minutes (see tables 3.1 & 3.2).

Table 3.1 Response Times by Spatial Typology for AS1 incidents

Spatial Type	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Main Towns	42%	38%	8%	4%	8%	44%
Small Towns	6%	18%	32%	23%	21%	10%
Rural Area	9%	22%	20%	21%	27%	46%
Sparse Rural Area	0%	6%	13%	28%	52%	1%
Region Total	**23%**	**28%**	**16%**	**14%**	**18%**	**100%**

Table 3.2 Response Times by Spatial Typology for AS2 incidents

Spatial Type	% of AS2 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Main Towns	25%	18%	8%	6%	43%	52%
Small Towns	11%	8%	13%	14%	54%	14%
Rural Area	5%	8%	10%	14%	63%	33%
Sparse Rural Area	2%	0%	6%	18%	75%	1%
Region Total	**16%**	**13%**	**9%**	**10%**	**51%**	**100%**

The current system of capture of ambulance records do not differentiate AS1 calls that are 'life threatening' and therefore while these figures appear low compared to UK targets the responsiveness to such incidents may in fact be higher than presented here, indeed without being able to isolate life threatening incidents the emergency workload is likely to be overstated for the region. In section 4.6.2 of the report (see table 4.6) the impact on responsiveness for calls classed

as life threatening is presented which confirms that increased numbers of incidents being responded to within eight minutes.

Response times of less than 19 minutes are achieved for 67% of all AS1 incidents (38% for AS2) for the region as a whole. Over 61% of AS2 incidents are being responded to in more than 19 minutes, while improvements in response times for AS2 incidents is desirable, additional refinement of the level of 'urgency' associated with particular AS2 incidents is required in advance of initiatives that aim to reduce the response time for this category of incident.

Across the region there are broadly similar response rates for each county at around 24/25% of all AS1 calls achieving a response time of less than eight minutes for three of the counties. County Laois is the exception to this where just 18% of calls were responded to within eight minutes. The presence of just one ambulance station in Portlaoise town is considered to contribute to this relatively poor performance. However it is important to note the presence of other stations close to the county border in Carlow, Athy and Roscrea which have the potential to attend AS1 incidents in County Laois. It would appear from the low rates of AS1 per capita in Laois, as presented in table 2.7, that indeed some AS1 incidents are already serviced from these stations, thus if these were considered, faster response times for AS1 incidents in the county would be achieved.

Table 3.3 AS1 Response time by County & Urban vs. Rural

Location	% of AS1 Incidents Responded by				
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.
Laois					
Towns & Villages	26%	26%	20%	15%	13%
Rural Areas	10%	21%	17%	24%	28%
County Total	18%	23%	18%	20%	21%
Longford					
Towns & Villages	44%	35%	8%	5%	7%
Rural Areas	4%	14%	21%	26%	35%
County Total	25%	25%	14%	15%	20%
Offaly					
Towns & Villages	40%	27%	9%	5%	20%
Rural Areas	85%	21%	21%	18%	32%
County Total	24%	24%	15%	11%	26%
Westmeath					
Towns & Villages	34%	42%	13%	7%	5%
Rural Areas	12%	27%	22%	20%	19%
County Total	25%	36%	17%	12%	11%

Note: *Towns and villages includes 'Main Settlements' and Rural Area includes 'Low Density Rural Areas'*

At the level of the seven main settlements the presence of an ambulance station has a significant impact on the response times for AS1 incidents. Table 3.4 lists the AS1 response times for the main settlements: Athlone, Portarlington and Edenderry have significantly lower response times than the other towns, with percentages of incidents responded to within eight minutes being less than 20%, whereas for the other four settlements around 50% and above of the AS1 incidents were responded to within eight minutes. With the new ambulance station in Edenderry it is reasonable

to assume the response time for incidents within Edenderry will improve and reach levels of other settlements.

Table 3.4 AS1 response times for Main Settlements

Main Settlement	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Athlone	19%	59%	15%	3%	5%	10%
Mullingar	59%	32%	4%	2%	2%	9%
Longford	49%	38%	5%	3%	5%	8%
Tullamore	60%	33%	4%	1%	2%	8%
Portlaoise	52%	38%	6%	2%	3%	5%
Portarlington	3%	3%	32%	39%	23%	2%
Edenderry	0%	1%	1%	2%	96%	2%

In section 4 of this study operational tactics are presented which will improve the response rates for all settlements.

4. Tactical Deployment Planning and Resource Assessment

4.1 Description of goals of Tactical Deployment Planning

4.1.1 Objectives

It is accepted that performance in terms of responsiveness, utilisation and patient outcomes can all be improved by a more dynamic approach to the deployment of available resources relevant to the spatial and temporal patterns of demand. To these ends, Tactical Deployment Planning (TDP) was selected as the process by which recommendations are to be made as to where sufficient resources should be placed in the busiest locations from time to time as demand dictates.

4.1.2 Outline of software systems

ACTIVE's Total Solution Mapping™ (TSM) system has been used to 'bring to life' all incident data provided by Spatial Planning Solutions (SPS). ACTIVE has not undertaken any independent verification of the data provided, the qualitative aspects of which are discussed elsewhere in this report.

TSM is predicated on connecting data-sets using geographic reference, especially where data are otherwise impossible to inter-relate. It provides a fast, accurate and flexible spatial and temporal analysis environment in which to explore the patterns of demand, design the optimum locations from which to respond and determine the work load for each response origin at different times of the day and days of the week. TSM has been configured using Navteq Ireland data purchased by the Pre-Hospital Emergency Care Council for the delivery of this project.

TSM contains a module called JourneyMan™, a sophisticated travel time boundary generator. This module allows the creation of a boundary to describe the potential travel time from any given point, using road speeds and congestion rules. These boundaries are used to further analyse incident data, and report on coverage of demand within, for example, an eight minute response time of a proposed or existing response origin (station or standby point). TSM can export data, and create prioritised lists of stations and response origins based on demand.

Most importantly, alternative deployment options can be safely modelled and remodelled in TSM, and potential improvements in performance can be forecast (subject to the constraints inherent in the data being analysed) before any risks are taken in the operational implementation of change.

Deployment plans are displayed in the ACTIVE TDP Viewer™ and run-in time with the clock on the computer. As the user moves through the day, the plan changes to reflect the priorities in the particular hour. Dispatchers also have the ability to scroll through the hours to plan for meal breaks, vehicle movements and shift changes.

TDP Viewer™ allows the dispatcher to allocate vehicles to each response origin and visualise the current coverage on a map. The map works with a simple traffic light system to show whether a post is manned, a vehicle is *en route* to post, or an area is not covered at all.

The dispatcher uses the prioritised lists and visualisation of geographic cover as a guide, along with their professional judgement, to place vehicles in the places most likely to have a call at any particular time of the day. This means that vehicles will be closer to the location of the next call, so that a vehicle can get to the incident quicker and be clear of that incident ready for another in a shorter overall time period.

Provision of the TDP of the Midlands region to the ambulance service is one of the key deliverables of the project. The fundamental configuration patterns recommended within the TDP of the Midlands region is contained within this report which provides the best means of examining its components. In the following sections we describe some of the key features of the TDP, its creation, the assumptions within the plan, and distribution of recommended 'response origins'. Readers are pointed to the package itself to gain a complete view of the TDP for the Midlands region.

4.2 TDP - Steps in Creation

4.2.1 Identify best vehicle positions and compare with existing stations

Using ACTIVE TSM loaded with the data provided by SPS, hotspot maps of demand have been created. AS1, AS2 and AS3 calls between 01/01/2006 and 31/12/2006 are separately analysed and counted firstly into 3km grid squares, from where the 500m concentration of demand within each "hot" 3km grid square can be found. Once the 500m hotspots are identified, a suitable point on the road network on which to "stand by" can be selected within the immediate vicinity, usually a fast road or crossroads to maximise response potential. This methodology identifies **Response Origins** across the operational region.

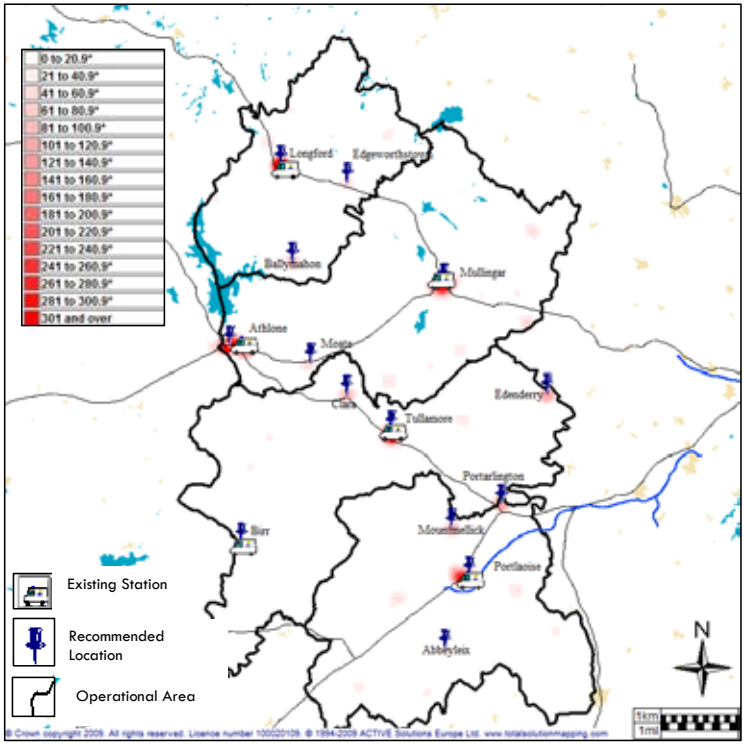


Figure 4.1 *Shows the locations of existing stations and recommended demand based response origins. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.2 Response Footprint Formation

Response Footprints are geographic areas that describe a part of the operational region that a response origin is likely to respond to. These are edge-matched boundaries to ensure complete coverage of the operational region and are drawn based on travel time boundaries but also take into account geographic features such as major roads, railroads, rivers and lakes. It is usual for these footprints to be verified by operational staff as to their reality. This is especially desirable where the road network being used is not complete. The response footprints should be subjected

to such a verification process before they are finally relied upon as a logical division of the operational region.

Once verified, the response footprints will ensure that every call gets counted once only in the prioritisation calculation. These boundaries allow each response origin to be prioritised by counting incidents into its response footprint.

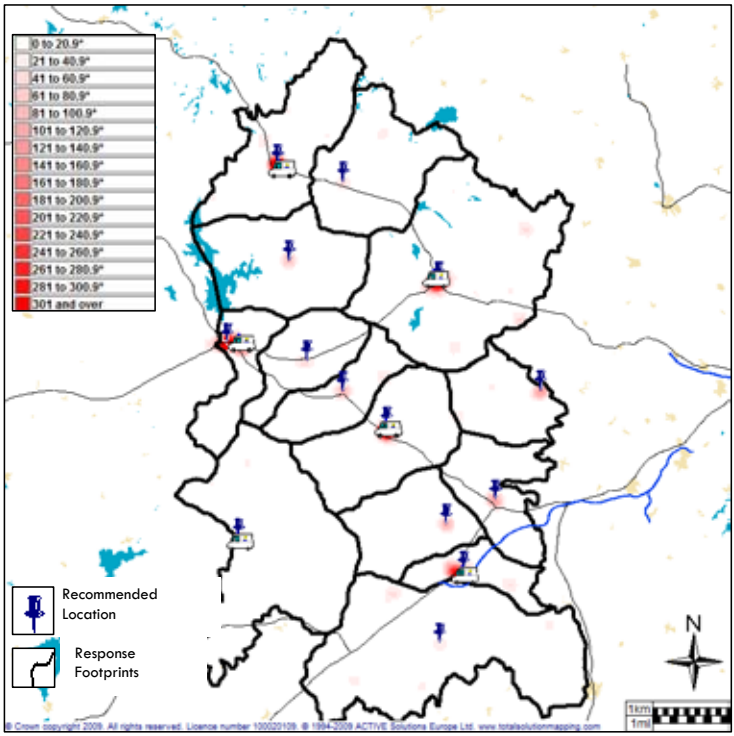


Figure 4.2 *Shows the locations of recommended demand based response origins and response footprints around each. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.3 Tactical Deployment Plan

The TDP Viewer™ contains prioritised lists of response origins based on the amount of demand for each hour of the week. Each vehicle is allocated to a response origin based on the demand in its response footprint. This means some response origins may have two or three resources, if warranted, in some hours, and many response origins will not be allocated vehicles hour after hour until the predicted pattern of demand warrants it. This provides a prioritised list of response origins for dispatchers to use as a guide, to position ambulances where the next call is likely to happen.

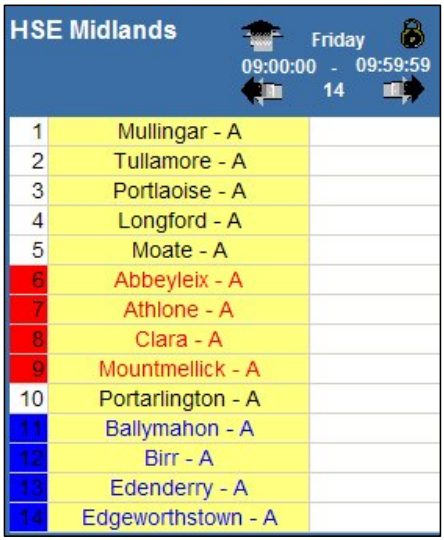


Figure 4.3 *TDP on Friday 09:00am-09:59am*

100% compliance with the plan is not to be expected. This would mean that all resources are in the right place at the right time, all waiting for the next incident. In practice, as the resources are better allocated to the areas of greatest demand, their utilisation rises and they rarely are waiting for a call. The plan needs to be used by dispatchers with some working knowledge of the geography of the operational region to ensure that post to post movements are prudently instructed.

The sample plan at Figure 4.3 is for Friday 09:00am – 09:59am. Each location is listed in priority order based on the demand in this hour, and the letter suffix after the location indicates first (A), second (B) or third (C) vehicles. If the dispatcher can cover the highest priority posts, responsiveness is likely to improve because the vehicles will be close to where the next incident will take place. Yellow cells show how many vehicles should be available in this hour and groups of blue or red location names signify posts of equal priority.

Within the TDP viewer the priorities for each station for each hour of each day are indicated (168 hours in total). The Viewer will thus indicate the ideal configuration of resources for the region. Decisions on deployment are left to the individual dispatcher with guidance for optimum deployment provided by the TDP.

4.3 Current Resource and Performance

In this section we assess the current resource availability in respect to demand profiles, this provides the background to identifying potential benefits to be gained from use of the TDP as it allows us to (a) assess how use of priority response origins indicated in the TDP will draw of the actual available resources (b) assess how current patterns of resource availability impact on performance (eight minute response for AS1 incidents) and (c) suggest possible changes in crewing and resource availability patterns across a week.

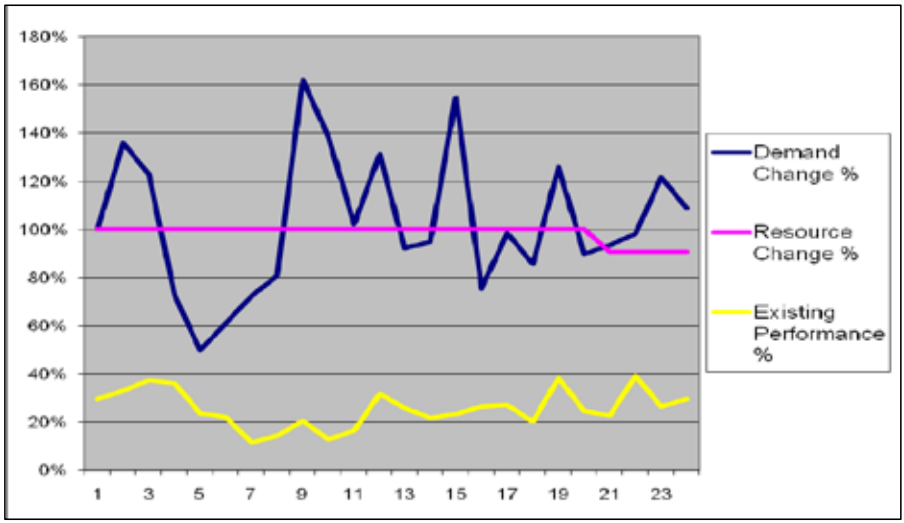
The table below shows the current number of scheduled vehicles available for all workload set out by hour for an average working week. This is derived from resource figures and crewing arrangements provided by the National Ambulance Service Midlands region.

Table 4.1

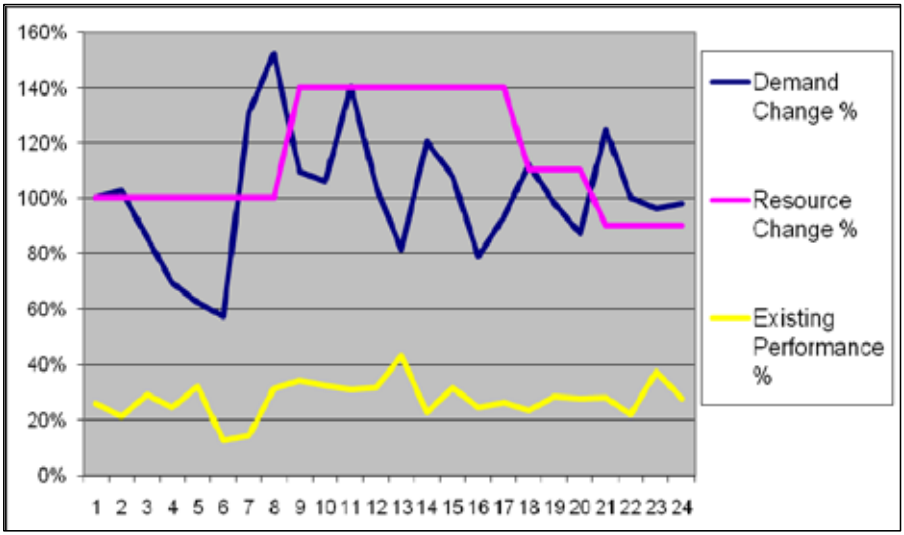
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10	10	10	10
Mon	10	10	10	10	10	10	10	10	14	14	14	14	14	14	14	14	14	11	11	11	9	9	9	9
Tue	9	9	9	9	9	9	9	9	14	14	14	14	14	14	14	14	14	11	11	11	9	9	9	9
Wed	9	9	9	9	9	9	9	9	14	14	14	14	14	14	14	14	14	11	11	11	9	9	9	9
Thur	10	10	10	10	10	10	10	10	14	14	14	14	14	14	14	14	14	11	11	11	11	11	11	11
Fri	11	11	11	11	11	11	11	11	14	14	14	14	14	14	14	14	14	11	11	11	11	11	11	11
Sat	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11

The series of graphs below show how workload changes throughout the day, and compares this with both the percentage of resource change and the calculated emergency performance. Emergency performance is based on all AS1 classification calls and the number of these that took eight minutes or less from time of call to time at scene.

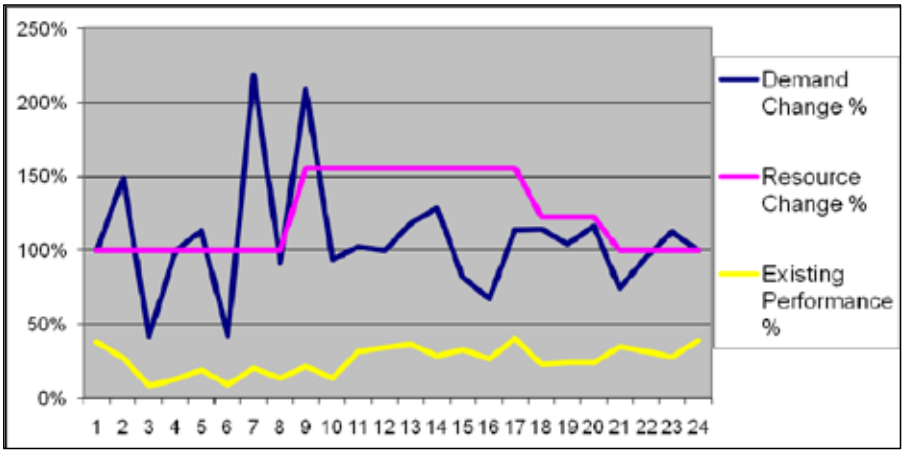
Sunday



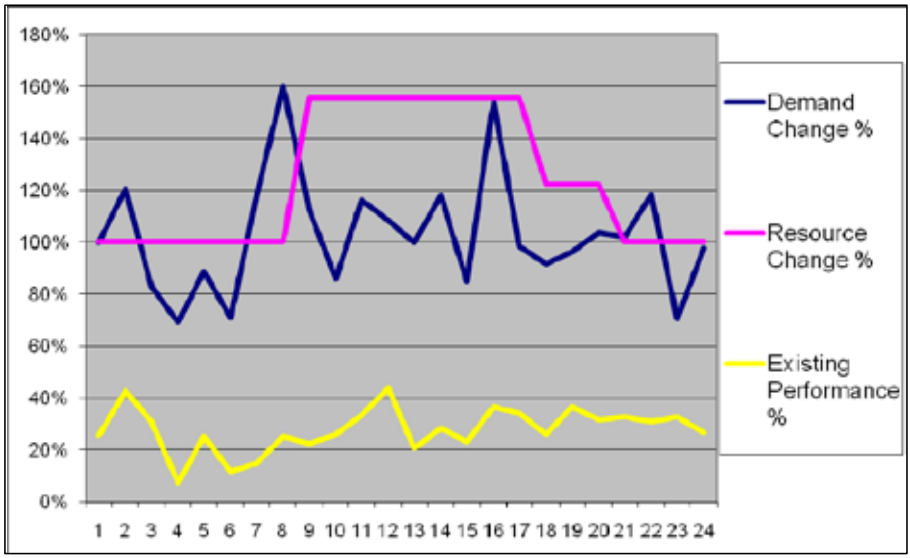
Monday



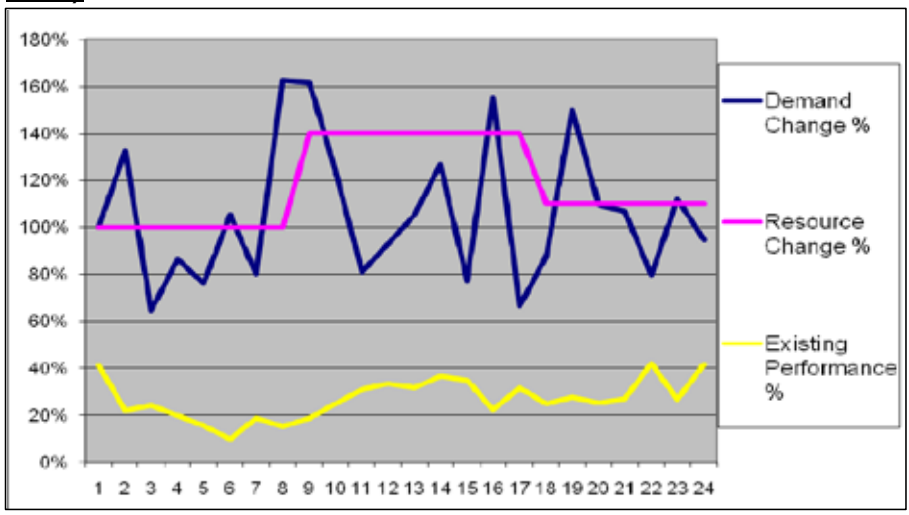
Tuesday



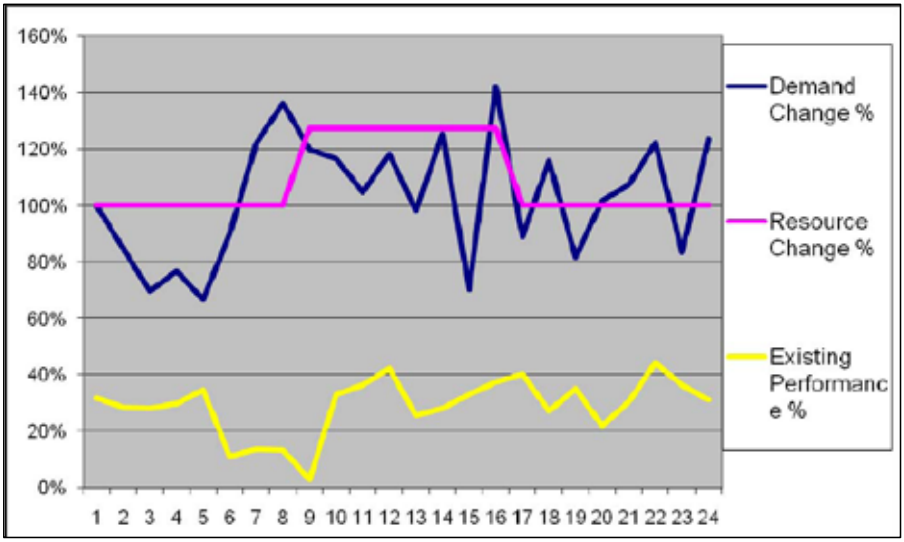
Wednesday



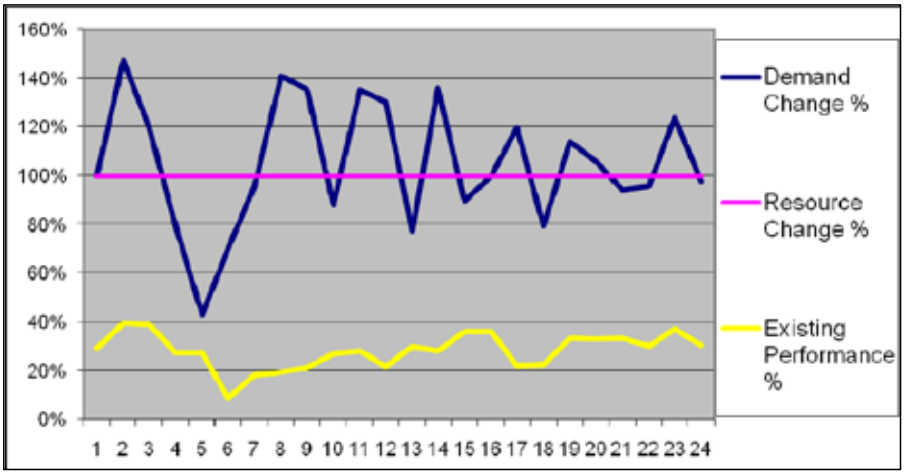
Thursday



Friday



Saturday



Across all of the days of the week the increase in the number of resources comes slightly too late in the morning, and consideration should be given to bringing the steep increase in resources forward by one or two hours.

4.4 Impact of PTS Workload

This section aims to give an insight into the impact of using emergency resources for all patient transport work. The National Ambulance Service Midlands region is aware that the absence of a comprehensive intermediate care or PTS fleet that serves all patients transport needs is draining the emergency resources available to the ambulance service for emergency work. Using the PTS dataset the actual effects can be studied.

Figure 4.4 below shows for each response footprint, how many PTS calls on average occur in each day and hour of the week.

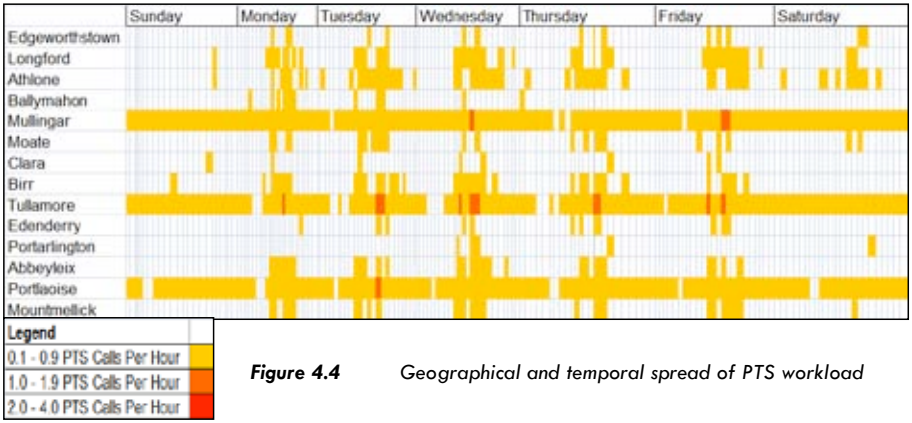


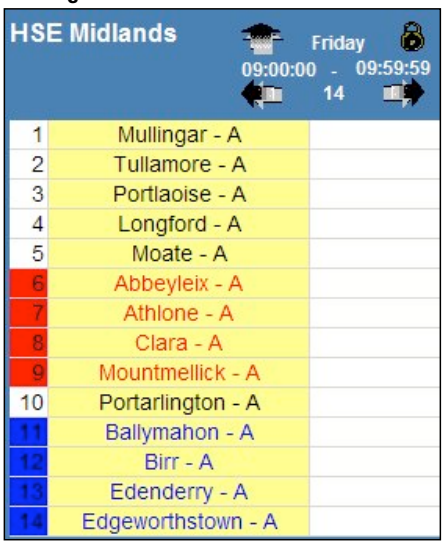
Figure 4.4 *Geographical and temporal spread of PTS workload*

This shows that Mullingar, Tullamore and Portlaoise have high PTS demand throughout the week. In some hours up to two PTS calls are being carried out, which means two less ambulances available to emergency work, for the average duration of the PTS tasks. The matrix gives an indication of where, when and how many vehicles would be needed if an intermediate/PTS fleet was to be assembled in the future.

The TDP is calculated including and excluding the PTS work. As the matrix suggests, all top prioritised vehicles would be needed in Mullingar, Tullamore and Portlaoise, because the demand is higher than anywhere else.

Figure 4.5 is for Friday morning 09:00am – 09:59am. This shows that if the PTS demand is included, Mullingar would get the first vehicle available. The picture is different if PTS data is excluded and the plan is based on emergency and urgent incidents only. However, variations due to PTS only occur in the upper half the prioritised list.

Including PTS



Excluding PTS

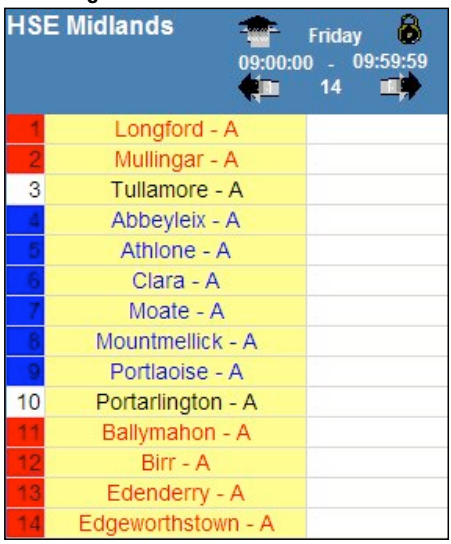


Figure 4.5 *Impact of PTS workload on the TDP*

4.5 Tactical Deployment Plan Impact Analysis

TDPs have been created for three different scenarios and a performance forecast has been calculated for each.

Scenario 1 **Using the TDP with no alternative fleet for PTS work and an abstraction factor to allow for vehicles off road, sickness etc.**

This assumes that the ambulance service continues to work as it is now. Numbers of resources available to cope with emergency incidents is reduced because the average 'clear to clear' time of each call is two hours. An abstraction factor of 35% is built in to reduce the number of planned vehicles, to allow for vehicles off road, sickness, meal breaks etc.

Scenario 2 **Using the TDP with a PTS fleet to do all PTS work, and an abstraction factor to allow for vehicles off road, sickness etc.**

This assumes that PTS work is not carried out by emergency vehicles unless the clinical needs of the patient genuinely require acute care transportation. This means 'clear to clear' times are reduced to an average of 80 minutes and more vehicles will be available. Again, an abstraction factor of 35% is built in to reduce the number of vehicles further, to allow for vehicles off road, sickness, and meal breaks etc.

Scenario 3 **Using the TDP with a PTS fleet to do all PTS work, and no abstraction factor.**

This assumes that all vehicles are available to be deployed for emergency calls and the numbers of vehicles are not reduced due to vehicles off road, sickness, meal breaks etc.

4.5.1 Performance Forecasts

In the absence of a specification of performance standards for the National Ambulance Service Midlands region, we have used the current UK standards as a parallel. Currently the UK is tasked with getting to 75% or more of all Category 'A' (life threatening) emergency calls within eight minutes. To achieve this standard, ambulance services need to be clear on what is and what is not a life threatening call and the need to be consistent in the calculation of start time. However, in forecasting performance, we have assumed the UK model exists.

For each scenario the predicted performance has been calculated. This is based on the response origins that would be covered in the TDP, and the number of calls covered within eight minutes of each response origin.

Notwithstanding the availability of MDPS codes the AS1 incidents are in the first instance assumed to be life threatening. This is quite a broad assumption and some (or perhaps many) AS1 calls may not be life threatening emergencies. Current performance forecasts are likely to be higher if life threatening incidents could be extracted from the data in the future. Later in section 4.6 of this report an analysis of life threatening calls derived from the MPDS codes associated with incidents is provided

Figure 4.6 below shows the current and the forecast performance for the different scenarios as previously described, against a response standard of eight minutes for all AS1 incidents. With the current level of resources, the forecast performance in Scenario 3 is 60.7%. All of these forecasts assume an average of two minutes activation time.

Performance Dashboard

Daily Overall Performance		Current Performance	Scenario 1 Performance	Scenario 2 Performance	Scenario 3 Performance
	Sunday	22%	47.2%	48.1%	57.0%
	Monday	21%	47.9%	50.8%	60.1%
	Tuesday	22%	50.5%	52.2%	59.9%
	Wednesday	24%	52.4%	53.2%	60.7%
	Thursday	24%	51.6%	53.4%	62.9%
	Friday	24%	54.0%	55.2%	64.1%
	Saturday	23%	51.0%	51.0%	60.2%
Monthly Overall Performance		23%	50.7%	52.0%	60.7%

Figure 4.6 *Eight Minute Response Time for AS1 incidents (current resource provision)*

Summary

- Implementing the TDP should improve responsiveness to emergency demand by 27.7% points (scenario 1).
- If an intermediate care fleet was introduced to take care of all PTS workload, a further 1.3% point increase in the number of AS1 calls responded to in eight minutes or less can be expected (scenario 2).
- Reducing the abstraction factor could move the ambulance service on by another 8.7% points (scenario 3).

4.5.2 Impact of Additional Vehicles

For each scenario we have calculated the predicted impact on performance. This is based on which posts would be covered in the TDP and the number of calls covered within eight minutes from each. We have then assumed the next highest priority post is covered by the new vehicle.

If resources are unlimited, then the best performance is 64% which is constrained not by available resources, but by the limited number of locations available to place the resources.

Thereafter, further performance gains will be available by the addition of resources, and the wider distribution of the response origins to amplify coverage in the wider, rural areas.

In scenario 1 the vehicle could be either an ambulance or an intermediate care vehicle which would thus free up an emergency ambulance for emergency work.

The impact of additional vehicles in scenarios 2 and 3 varies because the additional posts that can be covered aren't as high a priority compared to those covered in scenario 1.

In scenario 2 and 3, additional vehicles would be emergency ambulances because it is assumed a fleet of intermediate care vehicles is available to cover all PTS work.

Table 4.2

Additional Impact of 1 Vehicle (Emergency)			
Current	**Scenario 1**	**Scenario 2**	**Scenario 3**
0.00%	0.8-1.2%	2.5-2.9%	0.8-1.2%

4.6 Analysis of MPDS Data – 'life threatening' incidents

This aspect of the study concerns the capacity of MPDS data captured by the National Ambulance Service Midlands region and assumes that AS1 incidents can be defined and isolated as 'life threatening' emergencies from that data. The MPDS codes for AS1 are transposed into UK standards for definitions of Category 'A', 'B' and 'C'[3]. The categories comprise of:

Category 'A' Patients who are or maybe immediately life threatened and will benefit from a timely clinical intervention

Category 'B' Patients who require urgent face to face clinical attention but are not immediately life threatened

Category 'C' Patients who do not require an immediate or urgent response by blue light and may be suitable for alternative pathways of care.

This sections objectives are thus to:

- To calculate the current performance based on just those incidents that can be classified as Category 'A' based on the MPDS codes in the data using the comparable UK standards.
- To examine whether the response origins allocated in the principal Midlands study (based on all incidents and equal to the maximum number of resources available) apply to the Category 'A' incidents.
- To consider the impact of creating more response origins than the number of resources, based on the more diverse hotspot map of just Category 'A' incidents.
- To calculate:
    - the best life threatening % performance (against the UK standard of arrival at scene within eight minutes of time of call) using current levels of resources based on just Category 'A' incidents, and
    - any additional performance that additional resources could contribute.

[3] For a complete listing of the codes associated with the respective categories see Reporting dataset for MPDS Vers. 11.2 users (April 2005) Department of Health, United Kingdom, Ref. 4712 (www.dh.gov.uk).

4.6.1 Data Collection

Data for this study was extracted from the data used in the principal Midlands study. The principal Midlands study data consists of a total of 20,446 records, which are broken down according to incident class as shown in Table 4.3. Note that AS1 incidents amount to 41% of all incidents. AS1 was deemed to be a proxy for life threatening calls in the main parts of the spatial analysis for the Midlands region.

Table 4.3

Number of Incidents by Incident Class	
Incident Class	**No. Of Incidents**
AS1 Emergency	8,321
AS2 Doctor Urgent	5,073
AS3 Routine	7,052
Total	20,446

With 7,750 records (38%) in the principal data having an entry in the field called MPDS, a data-set based just on equivalent UK categories (A, B & C) standards can be extracted.

Table 4.4 shows the breakdown of all incidents by category. Note that the Category 'A' incidents amount to 13% of all incidents. Also note that some MPDs codes are classified as Category 'B'/'C' as the entries in the principal Midlands data are insufficiently detailed to be clearly in one category or the other.

Table 4.4

No. Of Incidents by MPDS Codes	
Category	**No of Incidents with MPDS Codes**
Category 'A'	2,594
Category 'B'	3,929
Category 'B'/'C'	389
Category 'C'	868
Blank Incidents	12,326
Unknown Codes	370
Total	**20,446**

Table 4.5 shows how incident class breaks down into category and this throws up some interesting questions, which are not answered in this study, regarding the appropriateness of either incident classifications, or MPDS final determination.

Table 4.5

Classification of Category A-C Incidents by MPDS Codes							
Incident Class	**Category 'A'**	**Category 'B'**	**Category 'B'/'C'**	**Category 'C'**	**Blanks**	**Unknown Codes**	**Total**
AS1	2,594	3,929	359	868	201	370	8,321
AS2					5,073		5,073
AS3					7,052		7,052
Total	**2,594**	**3,929**	**359**	**868**	**12,326**	**370**	**20,446**

4.6.2 Current Performance based on outcomes of the principal Midlands Study (TDP)

For this part of the study, we have assumed the application of equivalent UK performance standards based on reaching 75% of Category 'A' incidents within seven minutes 59 seconds of the time of call, and 95% within 18 minutes 59 seconds. For the purposes of this study, time of call is taken as the field with that name in the principal Midlands region data. The results presented are drawn from records provided by the ambulance service in the Midlands region, and have been selected on the basis of correct time stamps and coding procedures for the MPDS codes.

Initial analysis was performed on the data to help establish our understanding of the response rate to Category 'A' incidents using the Midlands region current deployment plan. Table 4.5 indicates that 29% of Category 'A' incidents were responded to in less than eight minutes and 72% in under 19 minutes. When all AS1 incidents are considered 23% of incidents were responded to within eight minutes and 67% in less than 19 minutes (see table 3.1).

Table 4.6

Response to Category 'A' Calls in Minutes			
Minutes	**No of Cat. 'A' Calls**	**Percentage (%)**	**Cumulative Percentage**
0-8	753	29%	29%
8-19	1,098	43%	72%
19+	723	28%	100%
Total	**2,574**	**100%**	

Note: *Time divisions set to correspond to UK standards*

Figure 4.7 displays the response origins designed and agreed in the principal Midlands region study overlaid with hotspots from the data for Category 'A' incidents only. This shows strong correlation between the demand concentrations in the principal study (which determined the response origin locations) and the concentrations of Category 'A' demand.

The Category 'A' incident data was processed by our Tactical Deployment Planning software to ascertain the forecast Category 'A' performance if the response origins from the principal study were retained and the current number of resources is assumed.

The Tactical Deployment Plan contains prioritised lists of response origins based on the amount of demand at each of 14 locations for each of 168 hours of the week. Each vehicle is allocated to a response origin based on the demand in its response footprint. This can mean some response origins may have two or more resources, if warranted, in some hours, and many response origins will not be allocated vehicles hour after hour until the predicted pattern of demand warrants it. This provides a prioritised list of response origins for dispatchers to use as a guide, to position ambulances when they come free in the location the next incident is most likely to occur.

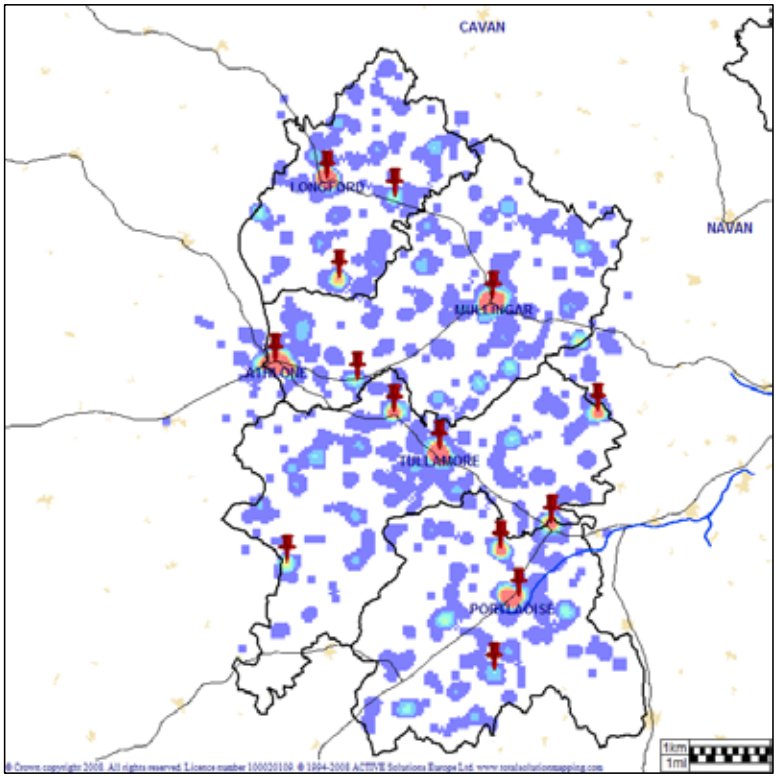
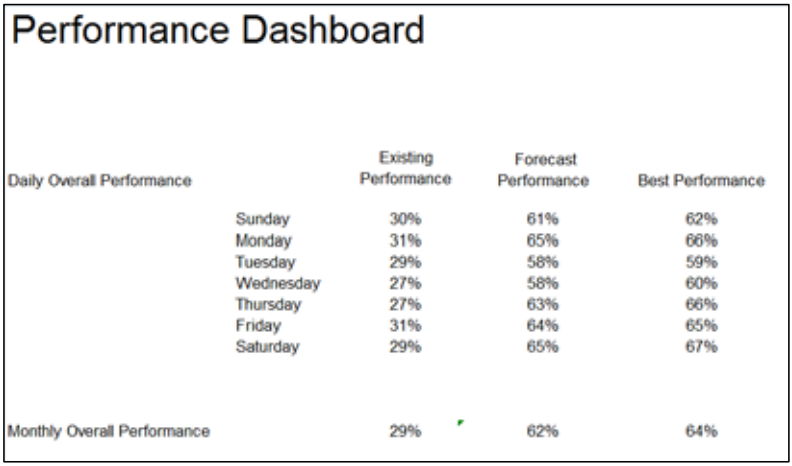


Figure 4.7 *Response Origins (main TDP) with Category 'A' incidents (blue)*

Figure 4.8 shows the existing, the best and the forecast performance against a response standard of eight minutes for all Category 'A' incidents, assuming the response origins used in the principal Midlands study and the existing level of resource. The existing performance matches the 29% already identified above. This is slightly higher than the existing performance calculated in the primary study across for all AS1 incidents of 23% (see table 3.1). The forecast performance that can be achieved using the Tactical Deployment Plan based on just Category 'A' incidents against the level of current resources is 62%. If resources are unlimited, then the best performance is 64% which is constrained not by available resources, but by the limited number of locations available to place the resources. All of these forecasts assume an average of two minutes activation time.



Performance Dashboard

Daily Overall Performance		Existing Performance	Forecast Performance	Best Performance
	Sunday	30%	61%	62%
	Monday	31%	65%	66%
	Tuesday	29%	58%	59%
	Wednesday	27%	58%	60%
	Thursday	27%	63%	66%
	Friday	31%	64%	65%
	Saturday	29%	65%	67%
Monthly Overall Performance		29%	62%	64%

Figure 4.8 *Eight Minute Response Time for Category 'A' incidents (see figure. 4.6 page 37 for comparison with AS1 calls)*

4.6.3 Effect of Category 'A' performance of additional ambulances and additional Response Origins

There follows an investigation into the impact of more ambulances and more response origins to test for increases in the level of performance for Category 'A' calls. Further work was conducted using continuous surface mapping techniques to identify where additional response origins should be located.

Figure 4.9 shows the response origin locations from the principal Midlands study as red pins, and it identifies a further 13 locations as numbered red rings that come through as potential locations for response origins. Having identified the 13 new locations the number of Category 'A' calls that were received at that spot were examined.

The cut off of demand at a location that determines whether it is to be included or not is arbitrary. Six out of the 13 new locations were chosen as new response origins based on them receiving the highest number of calls. The six new locations were added to the original 14 response origins.

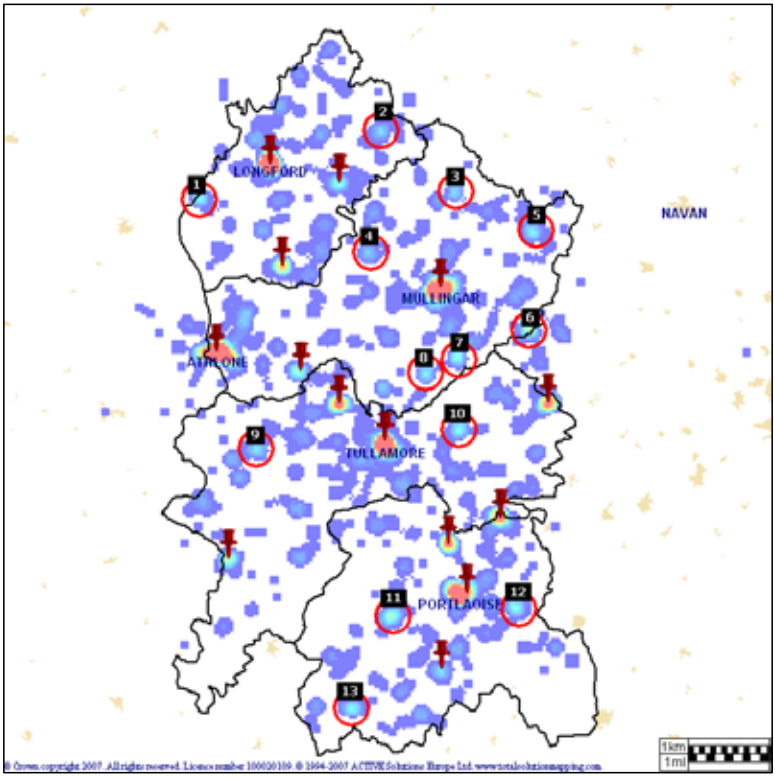


Figure 4.9 *Eight minute response time for Category 'A' incidents*

Response footprints were then created to take into account the further six response origins. Response footprints are geographic areas that describe a part of the operational region that a response origin is likely to respond to. These are edge-matched boundaries to ensure complete coverage of the operational region and are drawn based on travel time boundaries but also take into account geographic features such as major roads, railroads, rivers and lakes. It is usual for these footprints to be verified by operational staff as to their reality. This is especially desirable where the road network being used is not complete or the areas of coverage are remote. The response footprints should be subjected to such a verification process before they are finally relied upon as a logical division of the operational region.

Once verified, the response footprints will ensure that every call gets counted once only in the prioritisation calculation. These boundaries allow each response origin to be prioritised by counting incidents into its response footprint.

20 response origins and resources (ambulances) were added to the Tactical Deployment Planning software. The results from the Tactical Deployment Plan were evaluated to establish the actual number of ambulances needed on the basis of incident patterns.

Figure 4.10 illustrates the number of ambulances required across the 168 hours of a week using the 20 response origins. It shows that with the present demand in the Midlands of Category 'A' calls the full 20 ambulances will not be needed. Apart from the early hours of Sunday morning

which is most likely to be the pubs and clubs closing times the demand does not reach higher than 14 ambulances.

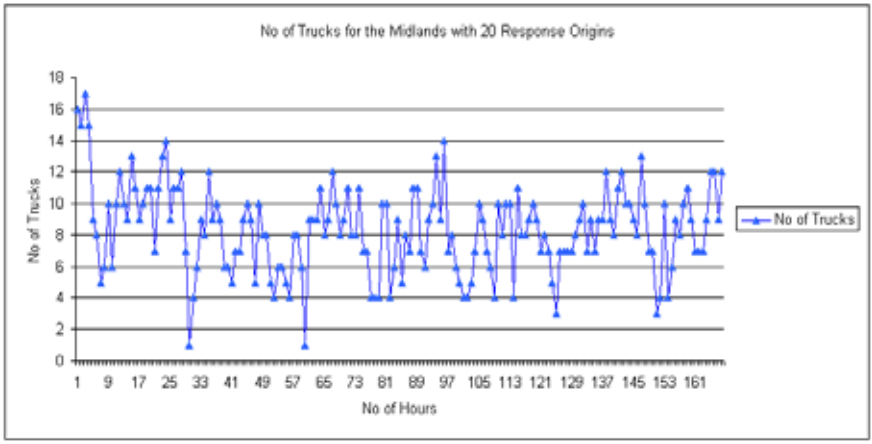


Figure 4.10 *Ambulances (trucks) required across an average week.*

Therefore, the levels of performance which are reported in Figure 4.11 below assume the current levels of resource (14), but with 20 alternative response origins available for deployment.

Performance Dashboard

Daily Overall Performance		Existing Performance	Forecast Performance	Best Performance
	Sunday	30%	63%	68%
	Monday	31%	70%	72%
	Tuesday	29%	61%	62%
	Wednesday	27%	63%	67%
	Thursday	27%	74%	80%
	Friday	31%	67%	68%
	Saturday	29%	71%	74%
Monthly Overall Performance		29%	67%	68%

Figure 4.11 *Performance Dashboard – Current Resources (14) with 20 alternative response origins (see figure 4.8 for comparison and figure 4.6 on page 37 for AS1 results)*

If we compare differences between the two performance dashboards we can see that the existing performance remains the same at 29% (see figure 4.8 page 42).

We have calculated the impact of extra vehicles on the Category 'A' demand to show the contributions extra vehicles can make to the forecast of Category 'A' performance based on 14 vehicles. The decision on where to put the extra vehicle is based on the twenty response origins

that are covered in the TDP and the number of calls covered within eight minutes from each. We have then assumed the next highest priority post is covered by the new vehicle.

If vehicles are unlimited, then the best performance is 68.1% which is constrained not by available vehicles, but by the number of locations available to place the vehicles and the six minutes response potential there from. Thereafter, further performance gains will be available by the addition of vehicles, and the wider distribution of the response origins to amplify coverage in the wider rural areas.

Table 4.7 *Impact of additional Vehicles on 'Cat A' incidents*

Number of Resources	Percentage Performance (%)	Percentage Increase (%)
14	66.6	
15	67.4	0.8
16	67.8	0.4
17	68	0.2
18	68.2	0.2
19	68.3	0.1

The forecast performance has increased by five points to 66.6%, whilst the best performance has only increased by one point to 68.3% (dealing only with the early Sunday morning demand), and the gap between the forecast and the best has halved. This supports the proposition that the ambulance system in a substantially rural and remote operational region like Midlands will perform better with a major increase in distribution in the deployment plan and a minor increase in resources.

4.6.4 Conclusions of MPDS Category 'A' analysis

We cannot verify the accuracy with which MPDS codes are appended to incident data. Assuming that normal ProQA quality standards [4] are applied, then those records in the data that have an MPDS code could be considered accurate, but with only 38% of the data used in the principal Midlands study having a useable MPDS code, the proportion that can be shown to be Category 'A', and therefore forming the foundation of this study could be significantly under-stated, the limits of the data must be borne in mind when considering these comments.

Currently the Category 'A' performance is 29%. When the TDP is applied with twenty response origins and 14 vehicles the performance rises to 66.6%. Table 4.6 shows the impact on performance gains by adding additional vehicles. The largest performance gain is achieved by placing one new vehicle. The percentage increase diminishes with the number of extra vehicles until the maximum performance of 68% is reached. More widely distributed response origins will generate an increase in performance for the current levels of resource. By increasing the number of response origins and the spread of those origins, the number of incidents that can be reached within a six minute travel time (assuming a two minute activation time) increases and thus performance will be enhanced.

[4] ProQA is based on the Medical Priority Dispatch System™ (MPDS) and provides a standardised format for carrying out the practice of priority dispatching. It is an automated system which operates by evaluating incoming information according to logical rules built on expert medical knowledge where patients must be assessed remotely. Those using this system must have a high level of EMD training, must have a firm understanding of the MPDS system, and must operate within a quality assurance environment.

4.6.5 Recommendations of MPDS Category 'A' analysis

- Apply training and consistent standards to the use of ProQA to provide a reliable final determinant for every incident.

- After, say, three months of compliance with recommendation 1 above, re-run this study on the basis of the Category 'A' (UK standards) incidents to establish a reliable hot-spot demand map from which to select, say, 28 response origins that push out into the rural areas more. Performance forecasts on the basis of this more reliable data will form the basis for a separate cost-benefit analysis of reconfiguring the Midlands ambulance system.

- Take the learning and recommendations from this study and roll this out to all ambulance services across Ireland to provide a more robust evidence base for Category 'A' performance improvements over time.

5. Demographic Trends and Service Hierarchy Implications

This section sets out the future population projections and infrastructural demands for the Midlands region comprising the counties Laois, Longford, Offaly and Westmeath. This analysis will be considered within the context of the National Spatial Strategy, the National Development Plan 2007-2013, the Midlands Regional Authority Regional Planning Guidelines 2004 and the relevant development plans.

5.1 Demographic and Regional Trends

The National Ambulance Service Midlands region corresponds with the Midlands region of the Regional Planning Guidelines. This area covers 6,500 square kilometres, representing 9.5% of the total area of the state. The Midlands region has encountered major changes in recent years with an increase of 20,000 persons between 1996 and 2002. The predominant areas of growth have been to the east of the region (within commuting distance of the Greater Dublin Area) and especially concentrated in the principal towns and settlements there. The increase in population can be largely attributed to increasing in-migration rates. The increase in overall population presents major opportunities for the area including the potential to reach critical mass. Approximately 10% of the regions employment is involved in agriculture which is above the national average and reflects the rural character of the region that has prevailed despite development. The region's central location on strategic national infrastructure presents opportunities for the development of the area. This allows easy access to the area making it an ideal location for industrial and commercial developments. However, it is vital that intra-regional links are made to allow the region to achieve its full potential as a competent economic and social base.
The recurring challenges of the region have been stated as:

- the need to harness the collective strengths of the region through effective co-operation between the planning and public authorities working in the region;
- the importance of developing strategic transportation links within the region to enable it to function effectively and competitively at a national level;
- the importance of focusing appropriate development at strategic points within the region to facilitate the achievement of critical mass; and
- the need to encourage more balanced development throughout the region, ensuring all parts of the Midlands utilise and combine their intrinsic and potential strengths to achieve their fullest potential[5].

The Midlands region is a predominantly rural area with 11.6% of its population in towns under 1500 persons; 16% of its population in towns of 1,500 to 9,999 persons and 25.2% of the population in towns of between 10,000 and 99,999 persons. This means that 47.2% of the population of the Midlands region resides outside these urban centres in principally rural locations. This is reflected in the above average participation in agriculture that persists in the region.

5.1.1 Population

In 2006, the population of the Midlands region stood at 251,664 persons. This represented an increase of 11.7% on the 2002 figure (225,363). The greatest percentage increase occurred in County Laois with a population increase of 14.1% bringing the population to 67,059 in 2006. This was followed closely by County Offaly where an increase of 11.3% occurred bringing the population to 70,868. Longford experienced a growth rate of 10.7% between 2002 and 2006 bringing the figure to 34,391. Finally, the population of Westmeath stood at 79,346 persons in

[5] Midlands Regional Authority Regional Planning Guidelines; pg. 6.

2006; an increase of 10.4% on the 2002 figure. These increases were all significantly above the national average of 8%. The population residing in the aggregate town area is largely similar for Offaly, Laois and Westmeath[6]. This is 42.2%, 40.5% and 47.4% respectively. Longford is far below the regional average with only 25.7% of its population residing in aggregate town areas. The state average is 60.7% (CSO 2006). The rural nature of the region poses a number of challenges to the ease at which services can be provided, including the provision of healthcare services.

At present the Midlands region possesses 5.8% of the total population of the state. According to the CSO *Regional Population Projections (2006-2021),* the Midlands region will see an increase of 4 in its population aged between 15 and 24 years. This will serve to reduce the dependency rate in the area and increase the number of people in the labour force; two attributes that will make the area a more attractive location for economic activity. This study also provides that between 2001 and 2021, the percentage of persons aged 65 years plus will increase nationally by nearly three-quarters. This statistic provides that the dependency rate of the country is to increase. At present the dependency rates of County Longford and County Offaly are 34.3% and 33.5% of the total population[7]. In Laois the dependency rate is 33.2% and in Westmeath the figure stands at 32.9%. The increasing population of older people will mean that demand for healthcare will increase which in turn will place increased demand for ambulance services. This together with the rural character of the Midlands will present challenges in relation to service provision.

The 2004 Regional Planning Guidelines for the Midlands indicated that a regional population of 250,000 by 2020 had been initially forecast from CSO projections published in 2001. It is apparent that this earlier projection underestimated the potential for growth as the 2006 population exceeded the figure by some 1,600 people.

More recently published forecasts from the CSO in 2005 envisage a population of 296,000 persons by 2021 from their 'medium' population projection. This particular scenario does not take into account the strong migration in to the region or considerations of stability of non-national households. However the 'recent' scenario is more sensitive to these factors and envisages a population of 322,000 persons by 2021. Based on the potential of the 'gateway' of Athlone, Mullingar and Tullamore to provide a counter balance for the Dublin region the RPG suggest a population target of 325,000 should be considered appropriate. Given recent trends and ongoing demand for residential development in the towns and villages located toward Dublin this scenario should be considered the most likely.

Table 5.1

Region	CSO 2002 Population	CSO 2006 Population	Percentage Change (2002 - 2006)	2021 CSO M1F2 ("Recent" Projection.)	2021 CSO M1F2 ("Medium" Projection)	RPG Population Target
Midlands	*225,363*	*251,664*	*11.7%*	*322,000*	*296,000*	*325,000*

Source: CSO 2005, Midlands Regional Planning Guidelines 2004.

[6] Aggregate Town Area are defined as towns with a population of 1000 persons plus.
[7] Dependents are taken to be those under the age of 15 together with those over 65 years.

The county development plans do not provide any localised projections that indicate the likely location of population growth at the county scale. However given the nature of recent growth the location of future development will likely be orientated within the town and villages and focused along principal transport corridors, with towns such as Portlaoise, Tullamore, Mullingar, Portarlington and Edenderry continuing to enjoy strong population growth. In respect of Athlone, while some continued growth is likely, it is not considered likely that this town will grow as strongly as the other principal centres.

5.1.2 Spatial Implications

The spatial implications of the aforementioned population trends will be continued increases for healthcare provision in the principal urban areas. As population growth in more rural and isolated parts of the region will be stable and reduce in some cases there may be pressure to divert investment resources from these areas toward more urbanised growth areas.

5.2 Policy Documents

National Spatial Strategy:

The National Spatial Strategy (NSS) is a twenty-year planning framework with a core aim of achieving balanced social, economic and physical development of the regions. It provides that through the closer matching of where people live and where they work, a better quality of life can be achieved together with economic progression and higher environmental qualities. The NSS recognises that much of Ireland's recent prosperity has been focused in the Greater Dublin Area (GDA). This impacts the other regions of Ireland by reducing their comparative advantages which has meant that some regions are seen as less attractive to economic development when compared to the perceived benefits of the GDA. The Midlands region experiences some commuting from the region to the Dublin metropolitan area, especially from County Laois and east County Offaly. This is reflected in the fact that the populations of several towns in the east of the region grew rapidly during the inter-censal period 2002 to 2006. The population of Portarlington grew by 59.5% during this time while the environs of Portlaoise grew some 31.1%.

The NSS states that central to the development of the Midlands is the strengthening of the gateway region of Athlone/ Mullingar/ Tullamore. Also the centrality of the region located on national road and rail routes must be utilised together with enhancing the attractiveness of the towns and villages in the region. The NSS states that in addition to the gateway, other large towns such as Portlaoise and Longford can be enhanced in competitive terms in order to encourage development at a county level. Smaller towns such as Portarlington and Mountmellick in Laois and Birr and Clara in Offaly can be enhanced to add to the attractiveness of the region as a destination for population and economic development. Contingent upon this however is the improvement of the regions services, namely the healthcare services. The ability to serve the increasing population without diluting the quality of services will be necessary to ensure that future residents are not merely commuters to the GDA.

The NSS makes reference to the need to encourage enterprise development in the Border, Midlands and West region (BMW). The need to ensure critical mass is re-stated and that a strong enterprise base must be developed and nurtured. The deficit of demographic and infrastructural development in the BMW regions must be addressed to ensure that it avails of the enterprise opportunities likely to arise. The gateway and hub network will be an essential corner-stone for each of these regions. If the Midlands is to be an attractive location, it is vital that social infrastructure is in place to make the area an attractive place in which to work and live. Healthcare services remain a vital aspect in this regard.

National Development Plan 2007-2013:

The National Development Plan (NDP) states that between 2002 and 2006 the population of Ireland increased by 8%. Also, the populations of all seven regions increased at a faster pace that previous inter-censal periods. The greatest increases took place in the Mid-Eastern region (3.6%), the Midlands region (2.8% increase), the South-East (2.1%), West (2.1%) and the Border region (2%). The BMW region has grown at a slower rate that the more urbanised regions of the GDA and the South-East. This provides added stimulus for increasing the populations of the region's strategic towns. The Gateway Innovation Fund will provide funding for the development of the Athlone/ Mullingar/ Tullamore Gateway in order to guarantee increased growth by ensuring that key economic infrastructure, transport and services are in place. This gateway is based on the strategic development of the three proximate urban centres. The population of the three towns in 2006 stood at 45,388.
The strengths of this gateway include:

- its strategic location;
- its relative proximity to Dublin on the national route M/N/4/6;
- the prospect of excellent road connections to Limerick, Cork and Galway;
- upgraded rail links to Dublin;
- improving social infrastructure (e.g.) the improvement in healthcare provisions by the opening of the Midlands Regional Hospital;
- the Athlone Institute of Technology; and
- a good quality of life, especially in the three gateway towns.

The main challenges for the region include the relative small size of the subject towns and the difficulties involved when numerous authorities must agree a plan of action. The key development issues and investment requirements according to the NDP are:

- strengthening the R&D capacity of Athlone Institute of Technology and its linkages to industry/employers in the region.
- development of enhanced road and public transport links;
- development of strategic local roads and water services capacity to attract and facilitate development in the gateway towns;
- enhancement of tourist and amenity facilities;
- development of strategic sites as part of IDA Ireland's Strategic Sites Initiative;
- further development to the N52, with accelerated priority to the provision of the Tullamore bypass; and
- implementation of the Strategic Development Framework for the Gateway drawn up by the Local Authorities, including the establishment of a Gateway Coordination Fund.

The Midlands Regional Authority Regional Planning Guidelines:

The strategic vision for the region is that by 2020 the Midlands will be a sustainable, successful and equitable region full of opportunities. This is to be achieved by reaching critical mass in the gateway and county towns such as Portlaoise and Longford; developing the full potential of rural areas; offering a high quality of life contingent on the high quality environment of the area and harnessing the advantages of its geographic location in the heart of Ireland. Investment in

harnessing the advantages of its geographic location in the heart of Ireland. Investment in national roads, rail, telecommunications and social services as detailed in the NDP is vital. The RPGs go on to offer detailed guidance on precise projects requiring investment.

Figure 5.1 *Midlands Regional Planning Strategy*
(extract from Midlands Regional Planning Guidelines 2004) Portlaoise

The region is traversed by a number of nationally strategic road and rail routes that radiate from Dublin. National secondary and regional roads connect these main routes within the region but are in need of upgrading. Improvements discussed in the NDP will have major impact on accessibility within the region and will facilitate its progression by reducing travelling times. The Midlands region is bordered by five of the seven regions in Ireland and it is vital that inter-regional connectivity is maintained and improved to ensure balanced growth occurs in the future. The noted key future road infrastructure development as per the guidelines is to develop the North/South trade route (N52/N80) and interregional link N55/N62.

The RPGs have a principal aim of strengthening the regions urban structure. This urban structure is as follows;

Gateway:	Athlone/Mullingar/Tullamore.
Principal Towns:	Portlaoise and Longford.
Key Service Towns:	Birr, Edenderry, Granard and Portarlington.
Service Towns:	Abbeyleix, Clara, Edgeworthstown, Ferbane, Graiguecullen, Kilbeggan, Killucan-Rathwire, Kinnegad, Moate, Mountmellick, Mountrath, Rochfortbridge and Stradbally.
Local Service Towns:	Ballymahon, Banagher, Castlepollard, Clonmellon, Daingean, Kilcormac, Lanesboro, Rathdowney and Tyrrellspass.
Villages:	all villages throughout the region.

The development of this hierarchy is necessary to ensure that the region develops in a sustainable and equitable manner. Also this urban hierarchy offers guidance on the provision of services within the region. Depending on the service itself, a location can be chosen from this framework depending on the opportunities and constraints posed by each centre.

Improving transport will commence with upgrading connections between the gateway and principal towns. This is because it is the intention of these guidelines to channel the vast majority of imminent future development into the gateway. This has implications for service provision as extra services will be required by the additional population in these centres, however service provision must also be balanced. The remainder of the region would be at a disadvantage if services such as healthcare were centred solely in the principal urban centres of the region. This must be balanced against the need for critical mass to ensure the sustainability of the subject services and the need to access these services, (e.g.) hospitals, without undue delays.

Laois County Development Plan 2005-2012:

The development plan states that the county is to become more accessible by the completion of the Dublin/Limerick Motorway (M7) and the Dublin/Cork Motorway (M8). The provision of regional and county roads is an objective for the Council as is the protection of future routes from premature development. The Council has an objective in place to assist the provision of healthcare services with specific reference made to community-based care facilities such as health centres, day care centres, sheltered housing, family resource centres, youth work programmes, and residential care centres for children and those with special needs. The Council requires that such services are accessible and integrated with existing communities.

Offaly County Development Plan 2003-2009:

Offaly County Council has a number of policies regarding road improvements. The Council intends to remove bad bends and alter a number of traffic collision 'black spots' throughout the county. Completing a number of outstanding road projects is also high on the Council's list and this will contribute to the regions accessibility and hence attractiveness. The development plan recognises that the commuting patterns that have developed in the east of the county are not sustainable and that it is necessary to develop the economic base of the county to counter these trends. The plan also states that it is the intention of the Local Authority to seek special tax incentives for the rejuvenation of the economic and social life of areas adjacent to the Mid-Shannon Region. A detailed local area plan will be prepared to ensure sustainable policies are implemented.
In relation to healthcare provision, the development plan states that the Council will support the:

(a) development of public transport system linkages to healthcare facilities to reduce the amount of private traffic and also to reduce the risk of rural isolation;
(b) provision of a Day Care Centre for physically disabled people in Edenderry;
(c) development of Kilcormac Health Centre;
(d) encouraging primary care out-of-hours service in the main and satellite centres; and
(e) zoning of lands in appropriate locations adjacent to health facilities.

Westmeath County Development Plan 2008-2014:

Westmeath County Council is responsible for the maintenance of a county road network totalling 2,180 kilometres. The plan recognises the role of this road network in the enhancement of the gateway towns and other large towns. A number of specific road projects have been identified and will be carried out over the lifetime of the plan. These include a number of road re-alignments and bypasses. The pressure on rural areas from urban generated rural housing has been recognised and the Council has committed itself to preserving the rural character of the county. Westmeath has the greatest population residing in aggregate town areas in the region (47.4%). This may mean that different policy approaches will be necessary in Westmeath compared to the remainder of the region. The plan informs us that a population of 100,000 is necessary in the Midlands Gateway for it to be deemed viable. The present population is 55,000[8]. Achieving this population level together with providing the necessary services represents one of the greatest challenges faced by the region.

Longford County Development Plan 2003-2009:

In 2001 Peter Bacon & Associates prepared a report on the '*Economic Profile and Strategy for Economic Development for County Longford*'. The study identified two strands for the economic and social development of the county. This report deals with increasing output and improving access to and the availability of services (education, health, retail etc.). Given that only 25.7% of the county's population resides in aggregate town areas, the Bacon Report suggested that the Local Authority should ensure the clustering of houses rather than allowing a proliferation of one-off dwellings to continue. It also advised against over-sized housing estates. These measures were suggested to support cohesive communities but also to assist in the provision of services.

Longford County Council has a comprehensive number of road projects planned, with the implementation of accident reduction and traffic calming measures where appropriate[9]. The Council has produced strategic policies for the development of the county, that when completed will make the provision of all types of services far easier. The numerous road projects will allow greater access to the somewhat removed Midlands Regional Hospital and will undoubtedly reduce travel times for all journeys, making the county more attractive to investment and potential residents.

National Roads Authority:

The National Roads Authority (NRA) was formally established as an independent statutory body under the Roads Act 1993. Its primary function is the provision of safe and efficient road systems throughout the country. For this purpose, it has the overall responsibility for the planning and supervision, construction and maintenance of such roads. The provision of such infrastructure in the Midlands will prove vital to its continued development and hence its overall sustainability. The following road schemes are underway in the various counties of the Midlands Region.

[8] Westmeath County Development Plan 2008-2014; pg. 19.
[9] Details of projects contained in Longford County Development Plan 2003-2009; pg. 50&51.

County Laois:

Scheme:	Status:
N7 Monasterevin Bypass (Heath Mayfield)	Complete
N7 Castletown to Nenagh	Construction
M8/N8 Cullahill to Cashel	Construction
N8 Portlaoise to Cullahill/Castletown	Construction
N80 Mountmellick Inner Relief Road	Preliminary Design

County Offaly:

Scheme	Status
N52 Tullamore Bypass	Construction

County Westmeath:

Scheme:	Status:
N4 Mullingar to Longford	Constraints Study
N4 McNeads Bridge to Kinnegad	Complete
M4 Kilcock/Kinnegad	Complete
N4 The Downs Grade Separation	Constraints Study
N6 Kilbeggan Athlone (KMA)	Construction
N6 Kinnegad Kilbeggan (KTK)	Complete
N6 Kinnegad Athlone (KMA)	Construction
N52 Carrick Bridge to Clonfad (Dalystown)	Route Selection
N52 Mullingar Belvedere	Complete
N52 Mullingar Bypass	Complete

County Longford:

Scheme	Status
N4 Edgeworthstown Bypass	Complete
N4 Mullingar to Longford	Constraints Study
N4 Drumsna Longford (Dromod Roosky)	Complete
N5 Longford Bypass	Preliminary Design
N5 Longford to Scramoge	Feasibility Study

Road infrastructure is a major beneficiary of NDP funding. The Midlands region has a significant number of such projects underway together with several healthcare initiatives. These projects are adding to the capacity of the region, however much work remains to be done. Over €45 million was allocated to County Laois for national road improvements and maintenance. Major schemes currently under construction include the N8 Portlaoise - Cullahill/Castletown and the M8/N8 Cullahill - Cashel Road. In addition, over €12 million was allocated to non-national roads in the county in 2007. Also a number of health projects were completed in Laois in 2007, including the new Emergency Department in the Midlands Hospital which received funding of over €8 million.

A number of significant health projects were also completed in Offaly in 2007, most notably the New Midlands Regional Hospital in Tullamore, which received funding of over €98 million. Offaly had an allocation of over €7.6 million in 2007 for national road improvement programmes and over €11 million for non-national road schemes including the Phase 2 of the New Link Road, Banagher and the Tullamore - Kinnitty road.

A number of health projects were also completed in Westmeath in 2007, with total funding of over €10 million for capital projects in the county. Projects completed include accommodation at St. Mary's and a Transfer Rehab Unit at Mullingar Midland Regional Hospital. In relation to the improvement and maintenance of roads, over €15 million was allocated to non-national roads in 2007. Examples include the Clara/Camagh Link Road in Kilbeggan and the Garrycastle Bridge. Over €110 million was allocated for national road improvements and maintenance. The N6 Tyrellspass to Kilbeggan and N52 Mullingar to Belvedere national road projects were opened, and work has commenced on the €89 million Athlone-Ballinasloe Dual Carriageway.

In County Longford health projects received a total allocation of over €17 million in 2007. Over €8 million was allocated to non-national roads in the county in 2007. Examples include the Forgney - Ballymahon Road and the Longford - Mullingar Road at Townparks, Feraghfad & Blackbridge. Another €8 million was allocated for national road improvements and maintenance. Such funding led to the opening of the N4 Dromod Roosky Bypass.

This funding together with the designation of the Midlands region (together with the Border and West regions) as a NUTS II region allows the region to avail of significant funding. The Midlands is a region that Europe considers is performing below its potential and is therefore providing additional funds under its Structural Funds programme. This funding is being used to advance the region and make it a more sustainable designation for enterprise and population.

5.3 Development Trends Summary

The main challenges identified for the Midlands region were its road infrastructure deficits, the need to enhance the Midlands gateway and its predominantly rural character. Significant emphasis is placed on addressing the road network and subsequently significant funding has and continues to be made available for this. As progress continues, the region will become more accessible and more competitive.

There is a need to concentrate population in the Midlands gateway in order to reach its critical mass of 100,000 persons; effectively a doubling of its current population. The real challenge will be to achieve this without inflicting significant economic and social costs on the remainder of the region. Given the projected growth of the gateway, substantial investment in services such as health will be necessary. However this cannot be done at a cost to the remainder of the region. The difficulty lies in locating such services in areas that have the potential to reach critical mass,

but still be accessible to the remaining population in the region, including those in more remote areas.

The rural nature of the region remains an issue regarding service provision. It remains to be seen how the region will tackle this and whether the recommendations such as those indicated by Peter Bacon & Associates in Longford will be implemented on a regional scale.

6. Conclusions & Recommendations

This type of study is, to the author's knowledge, the first of its kind undertaken on 'real-time' ambulance records from an ambulance service in the Republic of Ireland. Early work by the project team was undertaken for the North-Western region and some similar trends in respect to increasing volumes of ambulance service activity were apparent. A similar Spatial Typology was adopted, as were similar techniques in respect to assessing response times and a similar methodology for the Tactical Deployment Plan.

Through the use of the Tactical Deployment Plan (TDP) the study has extended its scope to embrace not only a research agenda but also the operational context of service delivery in the Midlands region. The TDP demonstrates how the use of additional deployment points used in conjunction with operator knowledge, can make significant improvements on performance in the region. The analysis also demonstrates how the use of emergency ambulance resources in Patient Transport Services impacts on responsiveness to emergency incidents in the region. In the course of the project, preliminary findings were presented to ambulance staff in the Midlands region; the next steps for implementation and 'roll-out' of the TDP envisages continued consultation with staff to ensure operational relevancy of the 'response-origins' , respective crewing requirements and support for exact locations of deployment points.

Successful implementations of TDP in the UK have demonstrated the need for support from ambulance staff, engagement with other aspects of emergency care provision is also required. Much of these remain outside the scope of the current study; however we do identify where and when demand peaks occur for emergency services, this gives guidance to the types of interventions required.

The following recommendations reflect both the research and operational agendas of the study and therefore are intended to provide a context and framework for analysis of emergency service demand in other National Ambulance Service regions, but also progress the potential enhancements in the ambulance service for Midlands region.

R1) Transfer methods of analysis to other regions:

The findings in this study and the methods adopted provide a baseline for analysis of emergency service demand for other ambulance service regions. Extension of the analysis to other ambulance service regions will allow comparison with demand profile and performance attainment and provide a national audit on ambulance service activity. This information will provide a context to ongoing changes in healthcare provision, in particular in the context of the relationship of ambulance services to changes in management in primary care, pre-hospital emergency care and patient management within hospitals. This will be especially important in the future management of patient transport services.

R2) Future Data Capture and Patient information:

A pressing issue arising from this study is the need to identify 'life threatening' incidents within the AS1 incident type. There are recognised operational difficulties in this requirement, and we are aware of work in this regard being undertaken by the Pre-Hospital Emergency Care Council. An analysis of the records considered to equate to life threatening incidents was undertaken which demonstrated potential benefits of rigorous identification of 'life threatening' incidents. The findings demonstrated the operational imperative of continued implementation of MPDS into the ambulance

services and that this should apply ProQA (or equivalent) standards. This imperative also extends to information on patient needs for Patient Transport Services.

R3) TDP Implementation Support:

The TDP developed in this study has demonstrable significant potential benefits for enhanced responsiveness to emergency incidents in the Midlands region. The analysis demonstrated that without any additional crew or vehicle resources a 27.7% increase in achieving AS1 response times in less than eight minutes was likely. Management and staff support, together with appropriate training and consultation, is required to implement the TDP. In addition to a number of technical issues (principally concerning exact positioning 'response origins') there are significant changes in operational practice within the ambulance service that require management guidance. Ongoing support from all agencies concerned is required to ensure its successful implementation.

R4) Inter-regional methodology:

Ongoing developments in the HSE and the development of regional control centres present significant opportunities to develop ambulance services better suited to inter-regional service provision. The use of TDP's at regional level will support identification of optimal service configuration and it is recommended that a feasibility study of development of a large scale regional TDP be undertaken bearing in mind considerations concerning recommendations R2 and R3.

In addition to the broader recommendations above there are a number of specific recommendations and actions that are relevant to the Midlands region, these are:

R5) Revision of TDP:

Given the rapid population growth, ongoing urban growth and changes in infrastructure, updated TDP exercises will be required for the midlands within three to four years.

R6) Operational Implementation of TDP:

A programme of implementation of the TDP is required to realise the benefits demonstrated in this study. The programme will involve consultation and training with control staff in the use of the TDP viewer and the best means of integrating its use into normal operations. Identification of the exact positions of 'response origins' is necessary and these will need to be based around 'social' standby locations that can provide facilities required by staff to ensure their acceptance. Examination of existing HSE landholdings, General Practice Co-ops, or other emergency service sites will require consideration. Consultation with operational staff will be necessary for this aspect of the implementation strategy. There may also be Local Authority planning issues to be addressed at certain potential response origin locations.

Implementation on a phased basis in selected localities may be an appropriate strategy to the use of new deployment operations. Development of Community Responder schemes at selected priority areas should be put in place in conjunction to the TDP.

Ongoing monitoring of response-performance audits will be necessary to ensure the effectiveness of the TDP initiative. Control room staff should ideally undertake these audits and additional training may be necessary.

R7) Additional Response Origins based on 'Life Threatening' incidents

Performance analysis of response should focus on 'life threatening' incidents based on applying ProQA to provide reliable incident classification. When established re-run of the study on the basis of Category 'A' (UK Standards) should be used to identify additional hot spot areas and response origins within rural / smaller town areas.

R8) Addressing future demands

The analysis has demonstrated that high demand arises in urban centres and with continued strong population growth expected in the principal urban centres, that provision of future resources should be aligned to equitably address this growth. The TDP highlighted a requirement for the addition of a response origin in South County Laois. While inter-regional analysis may prove that existing facilities in adjoining centres, namely Carlow, Athy and Roscrea, in the interim period it is recommended that weakness in service provision in the South County Laois area should be addressed.

R9) Patient Transport Service & Inter-agency consultation:

Provision of PTS in the Midlands region presents a considerable drain of emergency resources. While information on specific patient needs was not captured in the AS3 records analysed in this study, there may be a case that the extensive use of emergency vehicles for PTS is not necessary. Additional analysis is required to assess how the use of intermediate care vehicles will help reduce reliance on emergency vehicles for PTS services. Inter-agency consultations between the ambulance service, GPs and hospitals will provide a starting point to re-directing PTS activity. Examination of patient-management practices at GPs, nursing homes and hospitals will help provide the background to the service demand peaks identified in the study and indicate measures that can be taken to smooth out PTS and AS2 peak workload.

Notes:

Notes

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