Demand Analysis and Tactical Deployment of Ambulance Services in the National Ambulance Service Mid-Western 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
Council

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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 HSE Mid-Western 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 recommendation 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 Mid-Western 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 Mid-Western 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 on 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 with senior 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 National Ambulance Service Mid-Western 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 as it also coincides with the census year 2006.

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.

Report Structure

Detailed findings under various sections are set-out in sections 2 to 4. Sections 2 to 3 examine spatial-temporal aspects of the ambulance records and emergency care demand for the area and section 4 sets-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, and Mr Frank McClintock, Assistant National Director of the National Hospitals Office. We would also like to thank Pat Daly, Chief Ambulance Officer, National Ambulance Service, Mid-Western 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 ambulance service. The Mid-Western service 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 GP's 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. 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 Mid-Western Ambulance Service's 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 Geo Directory particularly in rural areas and areas of low population. 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 20,785. 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 this study and are identified in table 2.2 as 'unique responded incidents with location'; there were 12,082 AS1 and 4,745 AS2 such incidents in the National Ambulance Service Mid-Western 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 listed in table 2.2 had either no 'at scene' time or no location information and the database 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 MW Region				
Incident Type	**Emergency** **AS1**	**Doctors Urgent** **AS2**	**Routine** **AS3**	**Total**
Unique Responded Incidents with Location	12,082	4,745	9,715	26,542
'Stood Down' before 'At Scene Time'	1,552	211	6,865	8,628
'Stood Down' unspecified Location	132	40	1,436	1,608
No 'At Scene' time	160	547	257	964
Unspecified Location	405	911	1,153	2,469
Number of Incidents	14,331	6,454	19,426	40,211

2.2 Temporal Variability

The demand profile for AS1, AS2 calls received in the Mid-Western 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 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	1,128	577	1,705	36	19	55
February	1,019	509	1,528	36	18	55
March	1,205	591	1,796	39	19	58
April	1,201	524	1,725	40	17	58
May	1,177	515	1,692	38	17	55
June	1,125	520	1,645	38	17	55
July	1,284	540	1,824	41	17	59
August	1,215	517	1,732	39	17	56
September	1,192	532	1,724	40	18	57
October	1,276	552	1,828	41	18	59
November	1,176	529	1,705	39	18	57
December	1,333	548	1,881	43	18	61
Total Incidents	**14,331**	**6,454**	**20,785**	**39**	**18**	**57**
Average Monthly	***1,194***	***538***	***1,732***			

Within the region the average monthly rate for AS1 incidents was 1,194 per month and 538 for AS2 incidents. December had the highest numbers of incidents of any individual month; December also had the highest daily average of any month for AS1 calls with a daily average of 43 per day. This is higher than the annual daily monthly average of 39 AS1 calls per day. Within the December figures highest rates of AS1 calls occurred over the Christmas period which began in 2006 around Friday the 22nd of December. This corresponded with a broadly equivalent reduction in AS3 activity (see below).

2.2.2 Weekly Variation

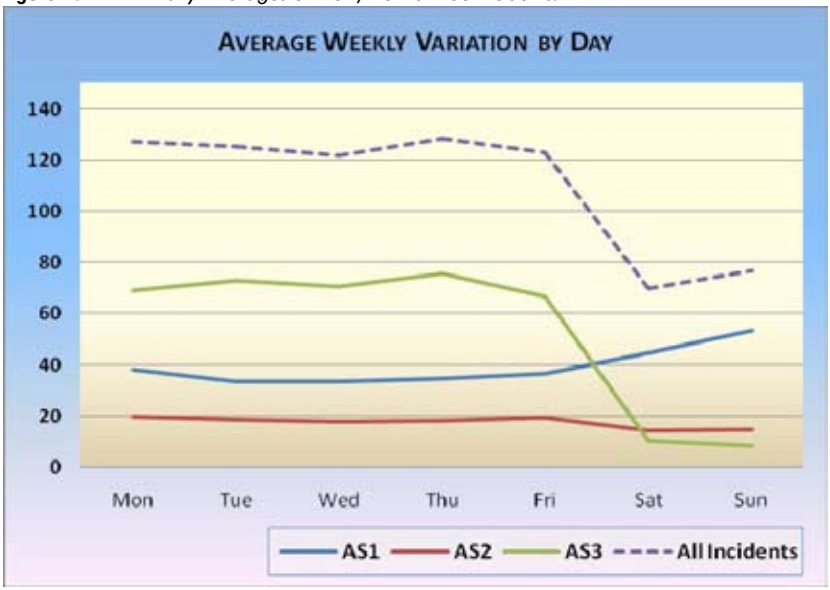
Incident rates across the week in the region are broadly static during week days but show a distinct increase in AS1 activity at the weekends. In contrast a strong reduction in demand for AS3 services and a smaller reduction in AS2 activity occurs during the weekends (see table 2.4 & figure 2.1).

Table 2.4

Average Weekly Variation by Day				
Day	**AS1**	**AS2**	**AS3**	**All Incidents**
Mon	38	20	69	127
Tue	34	19	73	125
Wed	33	18	70	122
Thu	35	18	76	129
Fri	37	20	67	123
Sat	45	14	11	70
Sun	53	15	8	77
Total Weekly Average	**276**	**124**	**374**	**773**
Average Daily	***39***	***18***	***53***	***110***

The busiest day is Thursday; however demand for ambulance services on this day is only marginally higher than other week days. Overall demand falls during the weekend; however AS1 activity on Saturdays and Sundays increases significantly, increasing to on average 45 and 53 AS1 calls on Saturdays and Sundays compared to an average of 35 AS1 calls on weekdays.

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



2.2.3 Daily Variation

On average for all days of the week there is an hourly rate of 4.6 incidents per hour, composed of 1.6 AS1 incidents, 0.7 AS2 incidents and 2.2 AS3 incidents per hour.

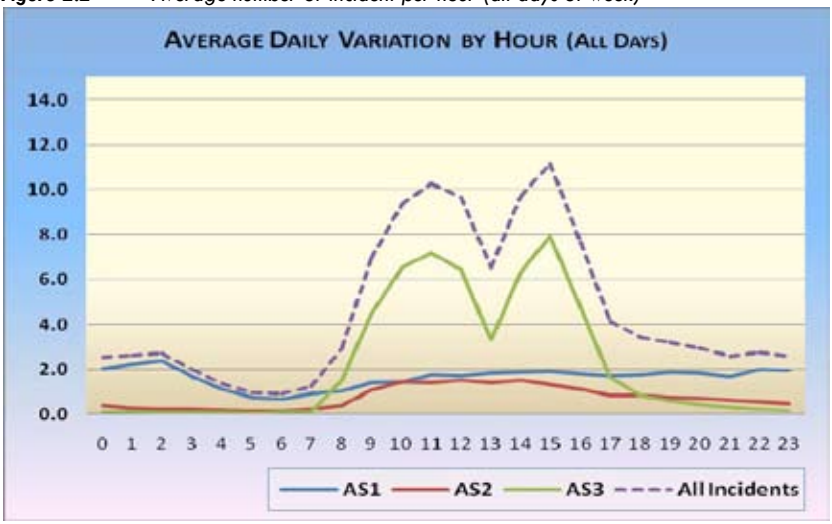
When aggregated to all days of the week the average hourly rate of AS1 incidents increases steadily through the day with lowest rates occurring around 06:00hrs (0.7 AS1 incidents per hour) to a maximum level around 02.00hrs (2.5 AS1 incidents per Hour).

AS2 incidents occur during 'working hours' (08:00hrs to 17:00hrs), with highest rates occurring between 10:00hrs to 14:00hrs. AS3 activity is considerably more variable with a bi-modal distribution either side of a very significant fall-off in demand at 13:00hrs. While AS3 activity is discussed in greater detail below it is important to note the impact that AS3 activity has on total numbers of incidents, where between 08:00hrs to 17:00hrs the AS3 incidents dominate the activity levels of the ambulance service (see figure 2.2).

Table 2.5

Average Daily Variation by Hour (All Days)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***1.64***	***0.7***	***2.2***	***4.6***
Ave. 08.00 to 18.00	*1.65*	*1.2*	*4.6*	*7.4*
Ave. 19.00 to 07.00	*1.62*	*0.4*	*0.2*	*2.2*

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



As already noted there are different incident rates during weekend hours compared to weekdays, for this reason figures 2.3 and 2.4, and tables 2.5 and 2.6 illustrate incident rates for hours during the weekend and weekdays respectively.

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

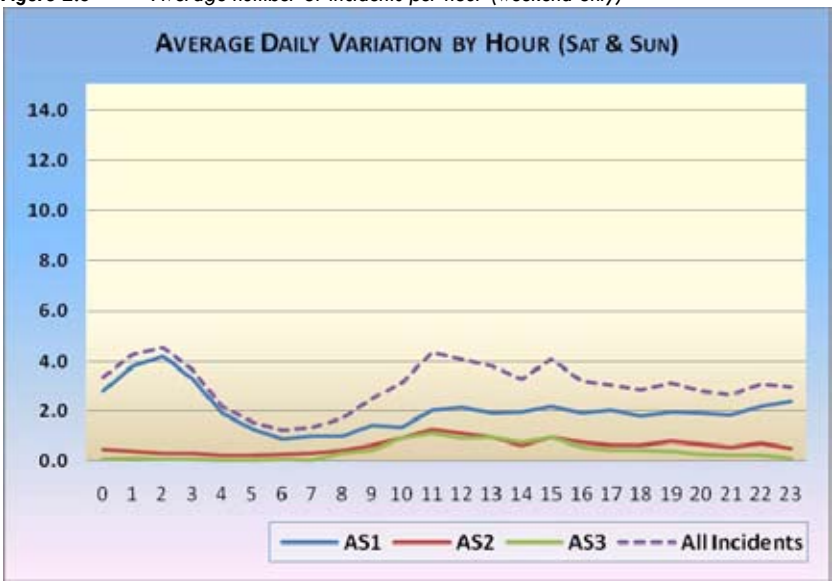


Table 2.6

Average Daily Variation by Hour (Sat & Sun)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***2.05***	***0.6***	***0.4***	***3.1***
Ave. 08.00 to 18.00	*1.79*	*0.8*	*0.7*	*3.3*
Ave. 19.00 to 07.00	*2.26*	*0.4*	*0.1*	*2.8*

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

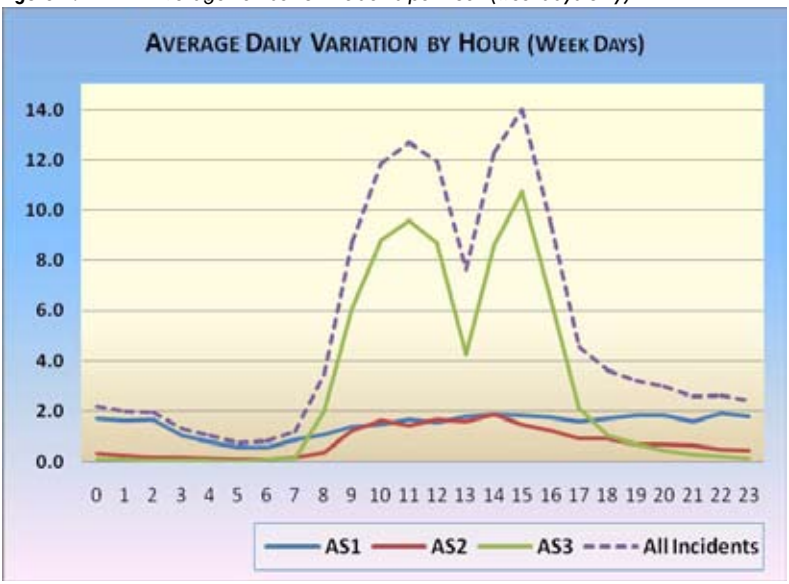


Table 2.7

Average Daily Variation by Hour (Week Days)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***1.48***	***0.8***	***3.0***	***5.2***
Ave. 08.00 to 18.00	*1.60*	*1.3*	*6.2*	*9.1*
Ave. 19.00 to 07.00	*1.37*	*0.4*	*0.2*	*1.9*

At weekends demand on ambulance services from AS1 activity dominates the demand profile while demand for both AS2 and AS3 services drop significantly. The average hourly demand at the weekend is 2.0 AS1 incidents per hour compared to the 1.48 per hour for weekdays only. The average hourly rate of AS3 on Saturdays and Sundays is 0.4 compared to 3.0 per hour for weekdays (see tables 2.6 and 2.7).

The period 23.00hrs to 04.00hrs on weekend nights are the busiest times for AS1 activity with call rates approaching an average of 4.0 AS1 incidents per hour at around 02.00hrs. Day time demand for AS1 services is broadly similar to weekday activity with a somewhat more sluggish level of activity during the morning period (08:00hrs to 11:00hrs).

2.2.4 AS3 Temporal Activity

AS3 incidents represent 48% of all the incidents dealt with by the Mid-Western Ambulance Service. In total 19,426 unique AS3 incidents were recorded, this figure excludes those patient transport incidents that are regularly transported by taxi services but includes some 2,990 incidents that were subsequently 'passed to taxi' after sometimes being assigned to either a PTS vehicle or an emergency ambulance. The passing on to taxis of an AS3 incident after being registered within the CAD system can be prompted by a number of factors, including information gained on a patients condition and demand on the ambulance service's resources at a particular time.

The monthly totals for PTS incidents are listed in Table 2.8, on average the Mid-Western Ambulance Service deals with 1,619 incidents per month. The busiest month is January, while the quietest month is December. This is in contrast to AS1 activity where December was the busiest month. There is a steady reduction in AS3 activity during the year where despite some variability in total numbers from February to April the daily average per month broadly fell from around 56 to 58 calls per day early in the year to around 48 to 50 per day towards the end of the year.

Table 2.8

Average Monthly Variation (AS3 Incidents)			
Month	**AS3**	**% of All Incidents**	**Average AS3 Per Day**
January	1,811	52%	58
February	1,581	51%	56
March	1,758	49%	57
April	1,493	46%	50
May	1,795	51%	58
June	1,613	50%	54
July	1,616	47%	52
August	1,605	48%	52
September	1,554	47%	52
October	1,498	45%	48
November	1,625	49%	54
December	1,477	44%	48
Total	**19,426**	**48%**	**53**
Average Monthly	***1,619***		

The Mid-Western Ambulance Service used a number of specialised PTS vehicles for their AS3 activity but in the main the AS3 demand was carried out using emergency ambulances. PTS calls are also completed by other private services, often initially a PTS incident is assigned to either an emergency ambulance (most common) or a PTS vehicle, later for operational reasons these calls may be passed on to other available private resources (Taxi or private emergency ambulance or PTS vehicle). In addition it is common that an AS3 incident will be 'stopped' where either the transport was not required by a patient or was cancelled by the hospital/GP that made the initial request.

Figure 2.5 charts the variation in AS3 incidents by month, the reduction in AS3 incidents is apparent. The graph indicates the number of AS3 incidents assigned to the Mid-Western

Ambulance Service emergency ambulance or PTS vehicles, and also charts those that were completed by the service. Also indicated are the numbers of AS3 incidents that were ultimately under taken by other private PTS resources.

Figure 2.5 *AS3 Incidents by vehicle type assigned to and completed by.*

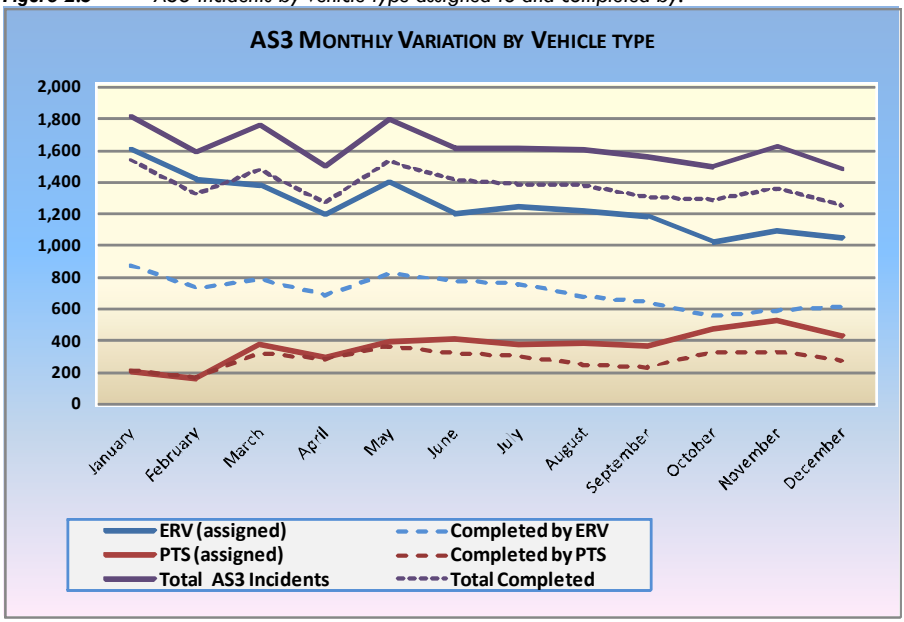
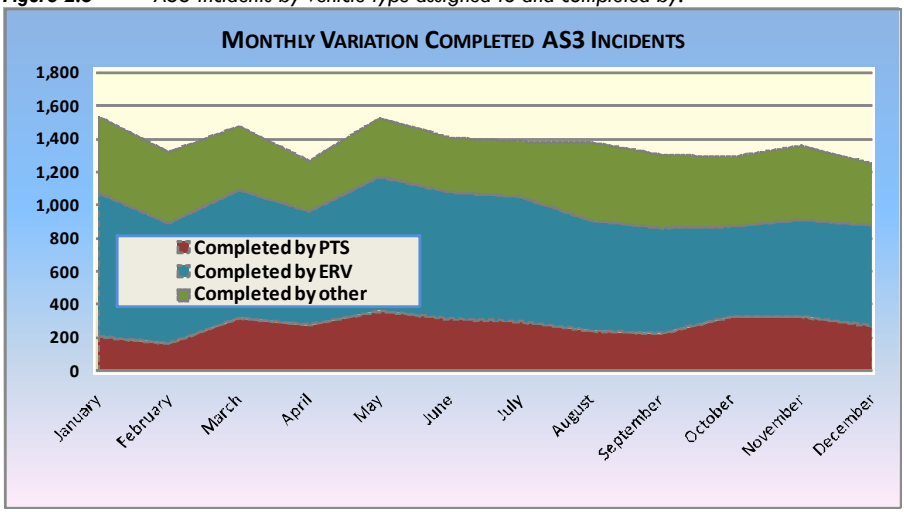


Figure 2.6 *AS3 Incidents by vehicle type assigned to and completed by.*



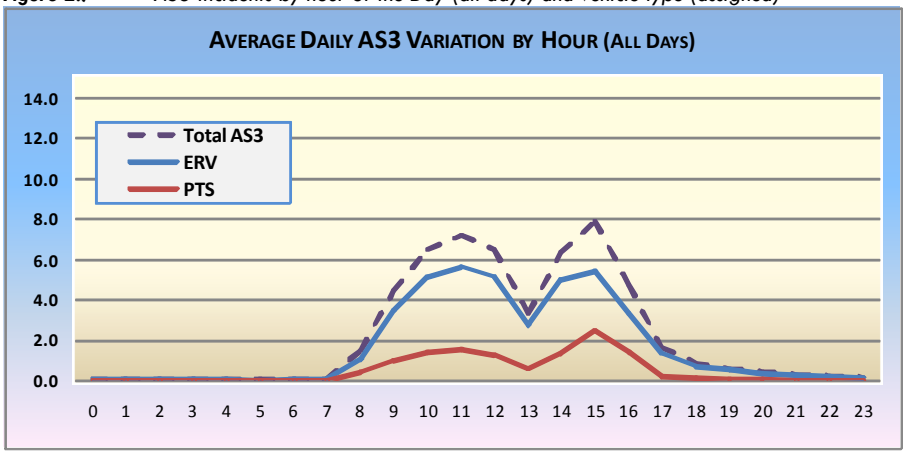
Despite the reduction in the total quantum of AS3 incidents the number of AS3 incidents completed by PTS vehicles increased during the course of the year. However it is also apparent that there is an increasing amount of AS3 incidents that are initially assigned to a PTS vehicle but are ultimately completed by a PTS vehicle. In respect to emergency ambulance most AS3 incidents are initially assigned to these vehicles but the difference between incidents assigned and those completed by PTS vehicles suggests that other resources are completing those incidents which are not being cancelled.

Figure 2.6 indicates the cumulative levels of completed AS3 incidents per month by vehicle type (emergency ambulance, PTS and private PTS resources). The steady increase in AS3 incidents being undertaken by private PTS resources would appear to be the recipient of many of those AS3 incidents that were initially assigned to emergency ambulance but not actually completed by them.

It has already been noted that AS3 activity is concentrated into certain days and hours of the week, whereby between 08:00hrs to 17:00hrs Monday to Friday 90.1% of all AS3 incidents are dealt with. At weekends just 5.1% AS3 incidents occur and 4.8% of AS3 incidents occur between 18:00hrs and 08:00hrs on weekdays.

In the course of an average working day rates of AS3 activity dip significantly during lunch time resulting in the most active hours occurring between 09:00hrs to 13:00hrs and 14:00hrs to 17:00hrs when 81.9% of AS3 incidents are managed, thus representing an average hourly call rate of 42.1 AS3 incidents over the seven hour period (see figure 2.7).

Figure 2.7 *AS3 Incidents by hour of the Day (all days) and vehicle type (assigned)*



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 AS1 and AS2 incidents during the study period, while there was little discernable difference between summer and winter rates, demand levels in December were marginally higher than other months, especially for AS1 incidents.

- 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 relatively 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 AS1 activity occurred between 00.00hrs and 04.00hrs with AS1 calls dominating the demand profile and a peak in activity at 01.00hrs.

- The numbers of AS3 incidents appear to be reducing during the year.

- AS3 activity is predominantly undertaken by the ambulance service's emergency ambulance fleet, however during the course of the year an increasing amount of this was undertaken by PTS vehicles. Other private PTS resources also undertook increasing numbers of AS3 incidents, where they were used to complete transport for incidents initially assigned to the emergency ambulance fleet.

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 in 2006) consisting of;

Limerick City	Ennis	Shannon
Nenagh	Thurles	Newcastle West

- Towns with a 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 then 10 persons per Km^2)
- Sparsely populated areas (population density of less than 10 Persons per Km^2).

Figure 2.8 *Settlements and current distribution of ambulance stations*

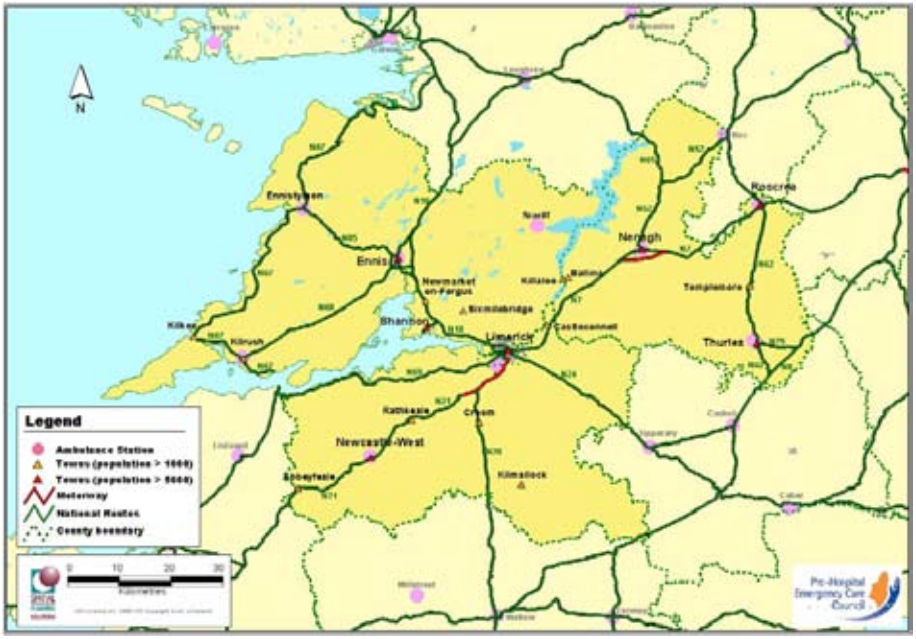


Figure 2.9 *Spatial Typology*

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

A notable feature of the Mid-Western Service's spatial typology is the high level of 'sparse population' in County Clare. This is primarily located in the peripheral upland area toward the Galway border. The amount of low population density in the county is significantly higher than ambulance service regions located in the east of the country but a common feature for regions located on the western sea board.

In population terms the most current census in 2006 indicated that the entire region had a population of 361,028 persons. From 2002 to 2006 the population of the region increased by 6.3% (see table 2.7), which is below the national average of 8%. Population growth was strongest in the towns with an increase of 7.0% compared to rural areas with an increase of around 5.8%. North Tipperary towns had very strong growth where an increase of 12.2% represented an increase of 2,676 people in the four year period. The strongest growing main settlements were Newcastle West (21%) Nenagh (17%) and Ennis (9%) (See table 2.9). Although the urban structure has consolidated in recent years, growth levels are not as strong as other national ambulance service regions and are below national averages for towns and villages.

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 2.9 which provides aggregations of each category of the area typology by county for AS1 and AS2 incidents.

Table 2.9 *Population & 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				
Clare						
Towns & Villages	38,568	41,730	8.2%	2,872	6.9	4.5
Rural Areas	58,544	62,826	7.3%	2,278	3.6	2.4
Low Density Rural Area	6,165	6,394	3.7%	85	1.3	0.7
Total	**103,277**	**110,950**	**7.4%**	**5,235**	**4.7**	**3.1**
Limerick (Incl. City)						
Towns & Villages	97,821	103,107	5.4%	7,779	7.5	6.2
Rural Areas	76,547	79,939	4.4%	2,584	3.2	2.0
Low Density Rural Area	936	1,009	7.8%	36	3.6	2.5
Total	**175,304**	**184,055**	**5.0%**	**10,399**	**5.6**	**4.4**
North Tipperary						
Towns & Villages	21,912	24,588	12.2%	2,377	9.7	6.4
Rural Areas	37,996	40,365	6.2%	1,179	2.9	1.9
Low Density Rural Area	1102	1070	-2.9%	26	2.4	2.1
Total	**61,010**	**66,023**	**8.2%**	**3,582**	**5.4**	**3.6**
Mid-Western Region						
Towns & Villages	**158,301**	**169,425**	**7.0%**	**13,028**	**7.7**	**5.8**
Rural Areas	**173,087**	**183,130**	**5.8%**	**6,041**	**3.3**	**2.1**
Low Density Rural Area	**8,203**	**8,473**	**3.3%**	**147**	**1.7**	**1.1**
Total	**339,591**	**361,028**	**6.3%**	**19,216**	**5.3**	**3.8**

Sources*: CSO 2006 & National Ambulance Service Mid-Western Region*
Note: *Towns & villages in County Limerick includes area defines as Limerick City by the CSO.*

The results indicate average rates of AS1 and AS2 incidents per head on population, where for the region as a whole there were 5.3 incidents per 100 persons, this is made up of 3.8 AS1 incidents per 100 persons with the residual, 1.5, 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 higher in urban areas compared to rural areas. Thus for example there were 6.2 AS1 incidents per 100 persons in Limerick towns compared with 2 AS1 incidents 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, a notable exception to this is in County Limerick.

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 are 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 2.10 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.

There is considerable variation in the levels of incidents that were responded to by the Mid-Western Ambulance Service. Towns in county Clare had lower rates of AS1 per head of population (except Kilkee); while significantly higher rates were recorded in Limerick and North Tipperary towns. Limerick City had rates of AS1 per head of population that were upper quartile of rates.

Table 2.10 *Urban Population and AS1 & AS2 incident rates in Mid-Western region*

Name	Persons 2002	Persons 2006	% Change	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Clare Towns							
Ennis	22,051	24,253	9%	1,647	6.8	1,016	4.2
Kilkee	1,260	1,325	5%	152	11.5	98	7.4
Killaloe	1,174	1,035	-13%	63	6.1	40	3.9
Kilrush	2,699	2,694	0%	237	8.8	137	5.1
Newmarket-on-Fergus	1,496	1,542	3%	118	7.7	68	4.4
Shannon	8,561	9,222	7%	496	5.4	380	4.1
Sixmilebridge	1,327	1,659	20%	81	4.9	63	3.8
Total Clare	**38,568**	**41,730**	**8%**	**2,794**	**6.7**	**1,802**	**4.3**
Limerick Towns							
Abbeyfeale	1,683	1,940	13%	137	7.1	88	4.5
Castleconnell	1,343	1,330	-1%	64	4.8	45	3.4
Croom	1,056	1,045	-1%	97	9.3	76	7.3
Kilmallock	1,362	1,443	6%	139	9.6	80	5.5
Limerick	86,998	90,757	4%	6,909	7.6	5,851	6.4
Newcastle West	4,017	5,098	21%	355	7.0	204	4.0
Rathkeale	1,362	1,494	9%	156	10.4	108	7.2
Total Limerick	**97,821**	**103,107**	**5%**	**7,857**	**7.6**	**6,452**	**6.3**
North Tipperary Towns							
Ballina (Tipp North)	1,185	1,861	36%	51	2.7	34	1.8
Nenagh	6,454	7,751	17%	835	10.8	540	7.0
Roscrea	4,578	4,910	7%	467	9.5	312	6.4
Templemore	2,270	2,384	5%	212	8.9	142	6.0
Thurles	7,425	7,682	3%	812	10.6	553	7.2
Total North Tipperary	**21,912**	**24,588**	**11%**	**2,377**	**9.7**	**1,581**	**6.4**
Urban Total	**158,301**	**169,425**	**7%**	**13,028**	**7.7**	**9,835**	**5.8**

Note: *Limerick City includes parts of County Clare and extends beyond the Limerick City Council boundary to parts of County Limerick*

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 make decisions on the 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, often in Dublin. The Mid-Western Ambulance Service 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 Mid-Western region. Thus the Mid-Western Regional Hospital in Limerick as the principal hospital for the region attracts a considerable proportion of inward and outward AS3 activity (see table 2.11). Despite this bias of AS3 activity centre on locations with major hospitals there remains a very high propensity for AS3 activity to be urban based, with numbers of AS3 incidents ranging from 8.4 to 9.8 incidents per 100 people compared to 0.8 to 0.1 in rural areas.

Table 2.11 *Spatial Typology and AS3 incident rates in the Mid-Western region*

Name	AS3 No. Incidents	AS3 Incidents per 100 persons
Clare		
Towns & Villages	4,079	9.8
Rural Areas	240	0.4
Low Density Rural Area	6	0.1
Total	**4,325**	3.9
Limerick (Incl. City)		
Towns & Villages	8,647	8.4
Rural Areas	632	0.8
Low Density Rural Area	2	0.2
Total	**9,281**	5.0
North Tipperary		
Towns & Villages	2,484	10.1
Rural Areas	198	0.5
Low Density Rural Area	3	0.3
Total	**2,685**	4.1
Mid-Western Region		
Towns & Villages	**15,210**	**9.0**
Rural Areas	**1,070**	**0.6**
Low Density Rural Area	**11**	**0.1**
Total	**16,291**	**4.5**

Sources*: CSO 2006 & National Ambulance Service, Mid-Western Region*
Note: *Towns & Villages in County Limerick includes Limerick City*

Table 2.12 below provides a matrix of 'pick-up' locations by town against the hospitals where patients were taken. This indicates the highest patient movements occurred to and from Limerick City. The Limerick Regional Hospital had 3,771 movements, with the majority of these originating from Ennis town; there was also strong representation from Nenagh. The high level of movements from Limerick City to Ennis General Hospital and Nenagh General Hospital in the main represents returning patients from the Limerick Regional Hospital. Thus the majority of AS3 activity concerns inter-hospital transport between these hospitals.

Cork University Hospital and the Mater Public were the principal 'out of region' hospitals attended by trips from main settlements. In total 7% (1,117) of trips concerned facilities out of the region, of these 628 were to Dublin (4%).

Table 2.12 *Pick-up Location and Hospital Attended AS3 incidents (20 plus incidents)*

Hospital Attended (To)	AS3 Pick-up Location (From)						
	Limerick	Ennis	Nenagh	Newcastle West	Thurles	Shannon	Total
Limerick Regional Hospital	1,124	1,661	903	52	23	8	3,771
Ennis General Hospital	1,283	493	1			2	1,779
Nenagh General Hospital	777	1	145		58		981
St Joseph's Hosp Ennis	157	595				1	753
St. John's Hospital	589	6	5		1		601
Croom Hospital	513	19	10		3		545
St Camillius's Hosp	409						409
Milford Care Centre Castletroy	345	2	4				351
Lakes N/H Killaloe	261	15	1				277
Cahercalla Hospital	37	232					269
Cork University Hosp	151	16	26	1	6		200
St. Ita's Hospital	187			1			188
Nenagh Manor N/H	34		136		4		174
Hospital Of Ass Thurles	26		107		8		141
Mater Public Hospital	92	19	16				127
Carrigorn Nursing Home	57	69					126
Our Lady's Hospital, Crumlin	117	1	4				122
Marie Gretti Nursing Home Kilm	121						121
Regional Maternity Hospital	89	16	12		1	1	119
Beechlodge Nursing Home Bruree	97						97
Galway University Hosp.	9	78	4				91
Roseville Nursing Home	88	1					89
Santa Maria Cratloe	77	10					87
St Conlon's Nenagh	25		59		1		85
St Theresa's Nh Kilrush	13	72					85
Cahermoyle Nursing Home	82						82
Adare & District Nursing Home	76			3			79
St James' Hospital	45	6	27				78

continued over

Hospital Attended (To)	AS3 Pick-up Location (From)						
	Limerick	Ennis	Nenagh	Newcastle West	Thurles	Shannon	Total
Dean Maxwell Roscrea	12		60		4		76
Rehab Dunlaoire	58	10			1		69
St Pauls Nursing Home Dooradoy	68						68
Galway Private Clinic	11	53	2				66
Clonmel Hosp. Co Tipp.	5	1	39		19		64
Rivervale Nursing Home	13		50		1		64
Rosemount Nursing Home	2	59					61
St Vincent's Public	42	5	13			1	61
Ashlawn N/H Nenagh	12	1	46		1		60
Ardeen N/H Thurles	4		48		7		59
St Luke's Hospital Kilkenny	16	33	9				58
Regina House Kilrush	10	44					54
Raheen District Hospital	25	26					51
Caherass Nursing Home Croom	49						49
Milbrea Lodge N/H Newport	41		6		1		48
Ard Na Ri Nursing Home	47						47
Beechwood Nursing Home Newcastle West.	41			2			43
Kilrush Community Hosp	2	41					43
Beaumont	26	6	8		1		41
Bushypark Borrisokane	3		37		1		41
Barringtons	5	33	1				39
Corbally Nursing Home	39						39
St Theresas N/H Thurles	4		34		1		39
Mater Private Hospital	21	10	5				36
St Joseph's Hospital (Limerick)	42	1					43
Bindon St Clinic		34					34
Padrio Pio N/H Holycross	3		23		6		32
Ennistymon Day Hospital	8	20					28
Good Council Nursing Home	26						26
Patterson's N/H Roscrea	6		14		2		22
St Anthony's Pallasgreen	22						22
Capphard Lodge Ennis	2	19					21
Clover Lodge N/Home Shinrone			21				21
Liscannor N/H	12	9					21
Bawnmore Bro Of Charity Limk	20						20
Other in Mid-Western region Location	*157*	*1*	*61*	*3*	*13*		235
Other Outside region	*86*	*14*	*35*	*0*	*27*		162
Not Specified	*713*	*218*	*176*	*20*	*35*	*1*	1,163
Total AS3 in Main Settlements	**8,534**	**3,950**	**2,148**	**82**	**225**	**14**	**14,953**

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 inter-hospital transport between Limerick, Ennis and Nenagh hospitals.
- AS3 trips from Ennis and Nenagh towns account for 40% of the total from all main settlements, the majority of these are to Limerick Regional Hospital.
- Trips for patients attending Dublin hospitals represent around 4% of the total volume of AS3 activity from the main settlements.

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 Mid-Western 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 at different 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) in 1991, 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 Mid-Western region, 51% of the area has a population density of less than 20 persons per Km^2. This area accounts for 14% 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; only Limerick City would qualify as an urban area. 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 jurisdiction 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 Mid-Western 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 Mid-Western Region

The average (median) response time for the study period for the entire Mid-Western region was 14.6 minutes for all AS1 & AS2 incidents. For AS1 the median response time for all incidents was 11.7 minutes and 30.7 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 27% of all AS1 incidents are responded to in under eight minutes. In the main settlements this rises to 38% of all AS1 incidents whereas in rural locations 5% of AS1 calls were responded to in eight minutes. A different pattern emerges for AS2 where just 7% of AS2 calls are responded to by eight minutes and 70% of calls are responded to in over 19 minutes (see tables 3.1 & 3.2).

Table 3.1 *AS1 Response Times by Spatial Typology*

Spatial Type	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Main Towns	38%	40%	10%	6%	6%	62%
Small Towns	12%	18%	22%	21%	27%	9%
Rural Area	8%	20%	20%	20%	32%	28%
Sparse Rural Area	5%	8%	13%	19%	55%	1%
Region Total	**27%**	**32%**	**14%**	**11%**	**15%**	**100%**

Table 3.2 *AS2 Response Times by Spatial Typology*

Spatial Type	% of AS2 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Main Towns	13%	20%	13%	10%	44%	46%
Small Towns	4%	10%	11%	16%	60%	12%
Rural Area	1%	5%	7%	12%	75%	40%
Sparse Rural Area	2%	0%	6%	4%	87%	1%
Region Total	**7%**	**13%**	**10%**	**11%**	**59%**	**100%**

It is not clear from the current system of capture of ambulance records whether all AS1 calls 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. Codes for Medical Priority Dispatch System (MPDS) are captured by the Mid-Western Ambulance Service. In the study of the Midlands region MPDS codes were queried to assess the potential impact of isolating 'life threatening calls'. It was demonstrated that there was a reduction in response times for such calls.

Across the region there is considerable variation at the county level with response times in County Clare the lowest with 23% of AS1 incidents responded to within eight minutes compared to North Tipperary at 30% (see table 3.3). The significant urban/rural difference is consistent for all counties within the region. In general around 8% of AS1 incidents are responded in less than eight minutes in rural areas whereas in urban contexts around 35% of AS1 incidents are responded to within the eight minute timeframe. Towns and villages in North Tipperary have the highest response rate at 40% of AS1 incidents achieving a response in less than eight minutes.

Table 3.3 *AS1 Response time by County & Urban V's Rural*

Location	% of AS1 Incidents Responded by				
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.
Clare					
Towns & Villages	35%	22%	12%	17%	14%
Rural Areas	8%	16%	15%	16%	26%
County Total	***23%***	***21%***	***15%***	***18%***	***22%***
Limerick					
Towns & Villages	34%	43%	12%	5%	7%
Rural Areas	2%	5%	5%	5%	9%
County Total	***28%***	***38%***	***13%***	***8%***	***12%***
N. Tipperary					
Towns & Villages	40%	30%	10%	8%	12%
Rural Areas	4%	11%	11%	10%	12%
County Total	***30%***	***27%***	***14%***	***12%***	***17%***
Mid-Western Region					
Towns & Villages	35%	37%	12%	8%	9%
Rural Areas	3%	8%	8%	8%	13%
Region Total	**27%**	**32%**	**14%**	**11%**	**15%**

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

For six 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. Shannon stands out as having significantly lower response times than other main settlements with just 2% of AS1 incidents being reached within eight minutes, for the other main settlements, all of which include an ambulance station, the percentage of incidents achieving a response of less than 8 ranges from 35% to 57%. Shannon also has by far the highest number of AS1 incidents that are not responded to in less than 25 minutes at 80% of AS1 incidents. After Shannon, Limerick City has the lowest response times with 35% of the AS1 incidents achieving less than eight minutes response, however unlike Shannon 81% of all AS1 incidents are responded to in less than 14 minutes. Ennis is achieving the highest response rates with 87% of AS1 incidents responded to in less than 14 minutes.

Table 3.4 *AS1 response times for Main Settlements*

Spatial Type	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	
Ennis	57%	30%	7%	4%	2%	8%
Limerick	35%	46%	11%	4%	23%	43%
Nenagh	47%	35%	5%	5%	4%	4%
Newcastle West	39%	21%	8%	7%	5%	1%
Shannon	2%	3%	15%	51%	10%	3%
Thurles	49%	29%	6%	4%	6%	4%
Main Settlements	**38%**	**40%**	**10%**	**6%**	**6%**	**62%**

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 TDP

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 PHECC 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 Mid-Western region to the ambulance service is one of the key deliverables of the project. The fundamental configuration patterns recommended within the TDP of the Mid-Western region are 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 software systems themselves to gain a complete view of the TDP for the Mid-Western 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 which utilised an emergency resource 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 area.

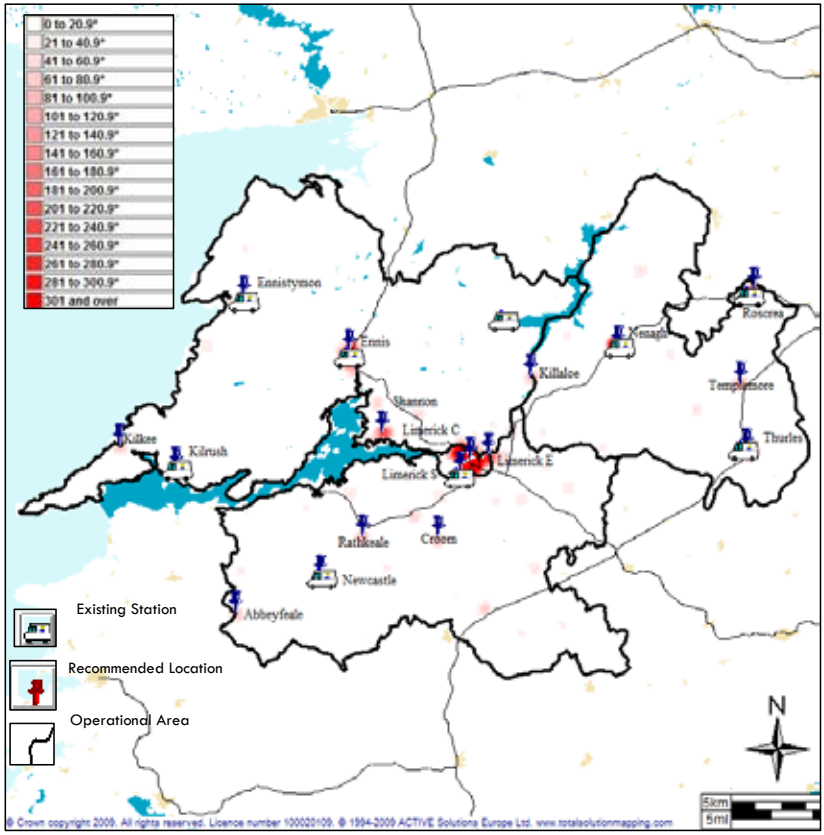


Figure 4.1 *Shows the locations of existing stations and recommended demand based response origins. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.2 Response Footprint Formation

Response Footprints are geographic areas that describe a part of the operational area that a response origin is likely to respond to. These are edge-matched boundaries to ensure complete coverage of the operational area 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 area.

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.

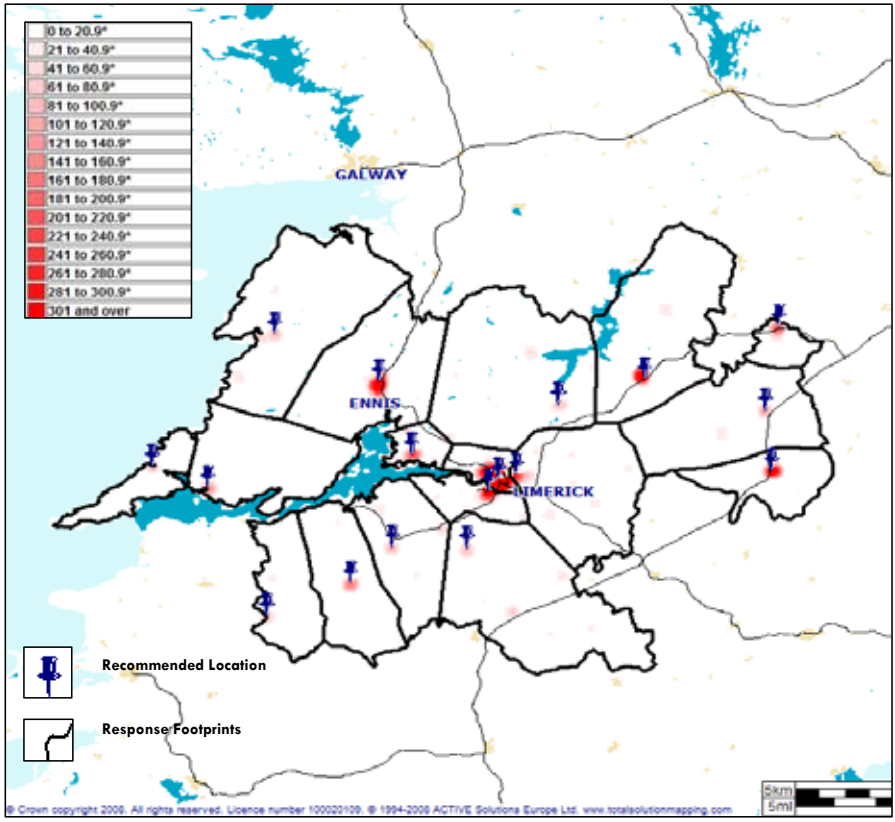
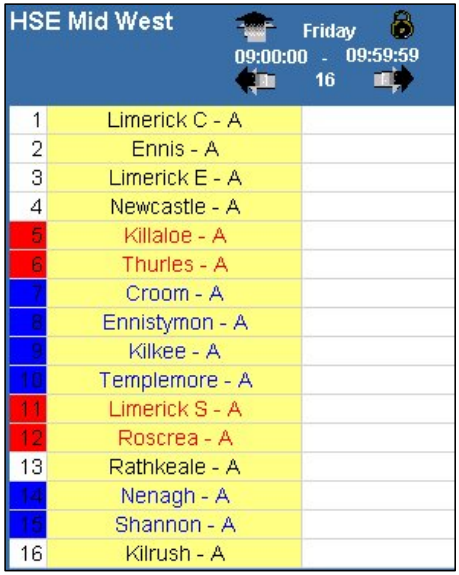


Figure 4.2 *Shows the locations of recommended demand based response origins and response footprints around each. 500m grid squares are coloured from white to red to show the density of incidents.*

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 emergency ambulances where the next call is likely to happen.



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 area 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.

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

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.

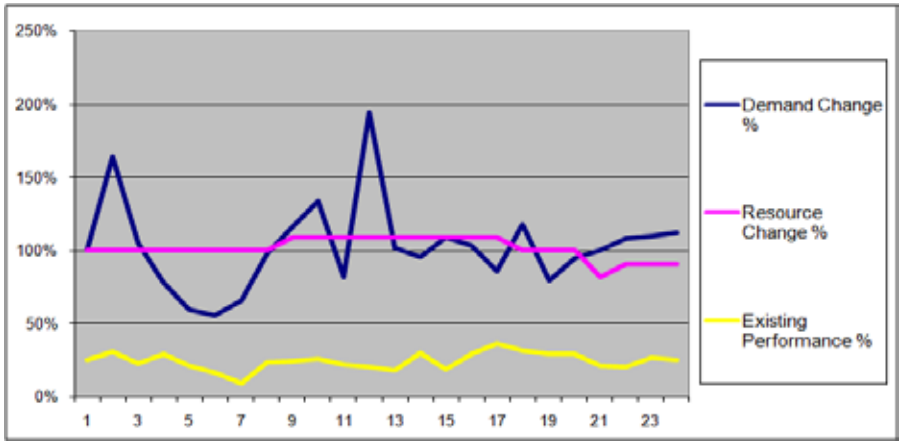
The table below shows the current number of scheduled vehicles available for all workload set out by hour for an average working week. This is derived from resource figures and crewing arrangements provided by the Mid-Western Ambulance Service.

Table 4.1

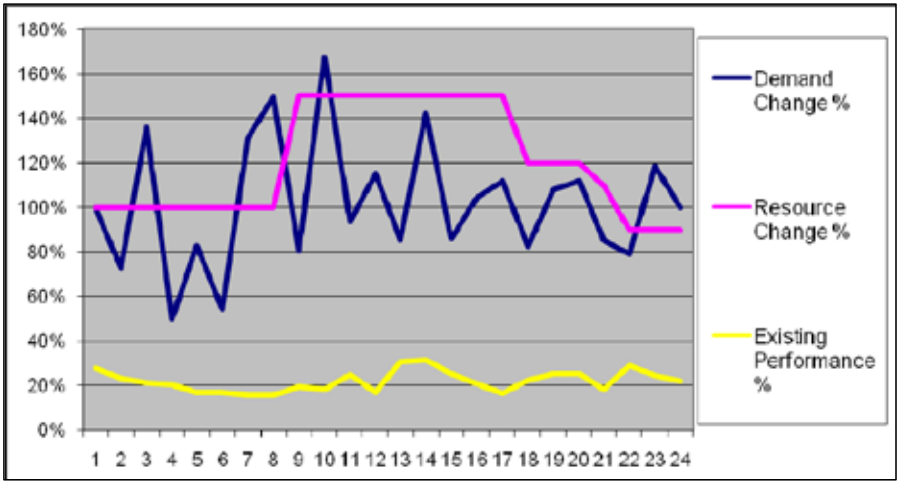
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	11	11	11	9	10	10	10
Mon	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	12	12	12	11	9	9	9
Tue	10	10	10	10	10	10	10	10	16	16	16	16	16	16	16	16	16	12	12	12	11	9	9	9
Wed	10	10	10	10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

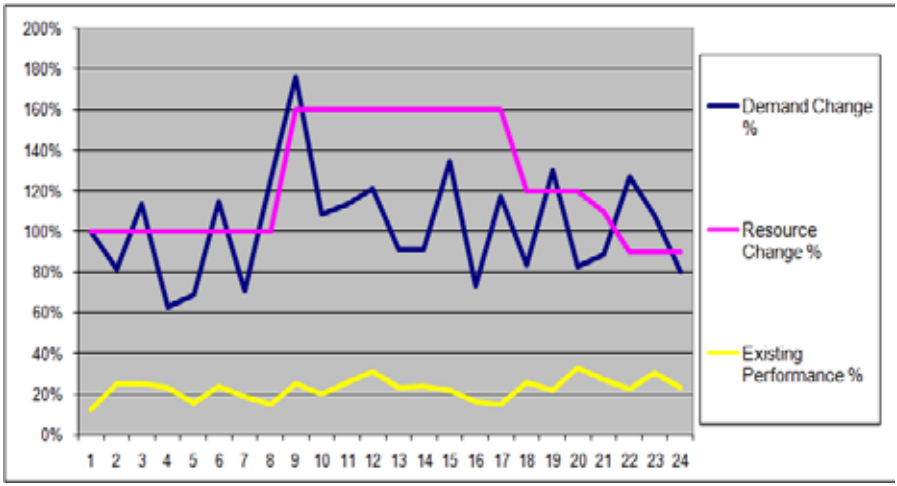
Sunday



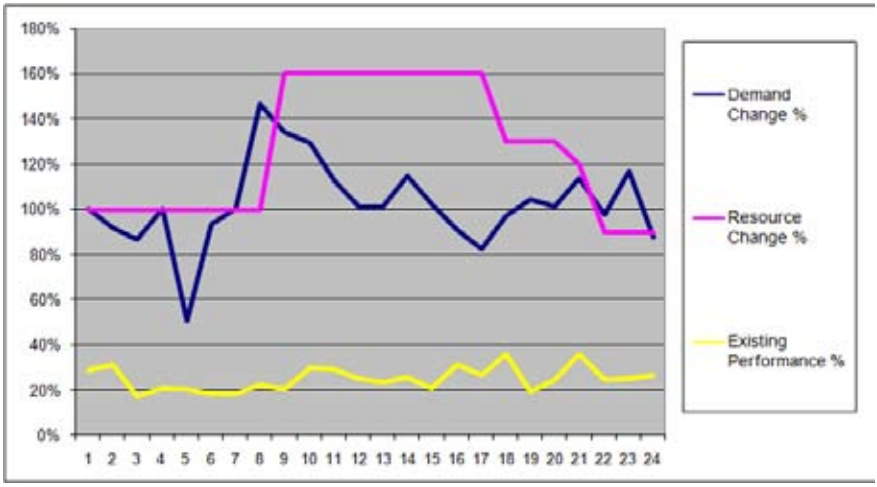
Monday



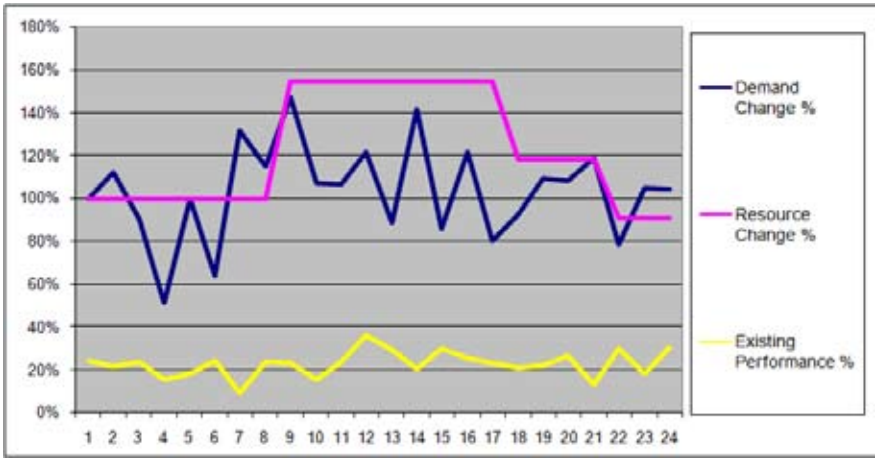
Tuesday



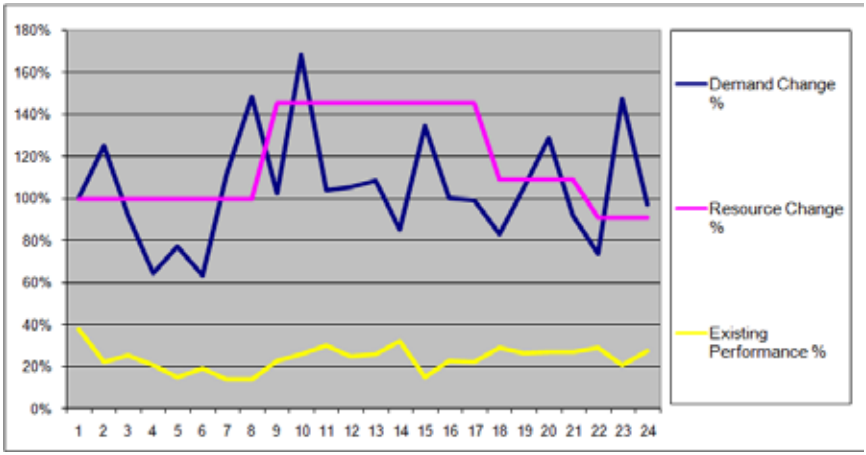
Wednesday



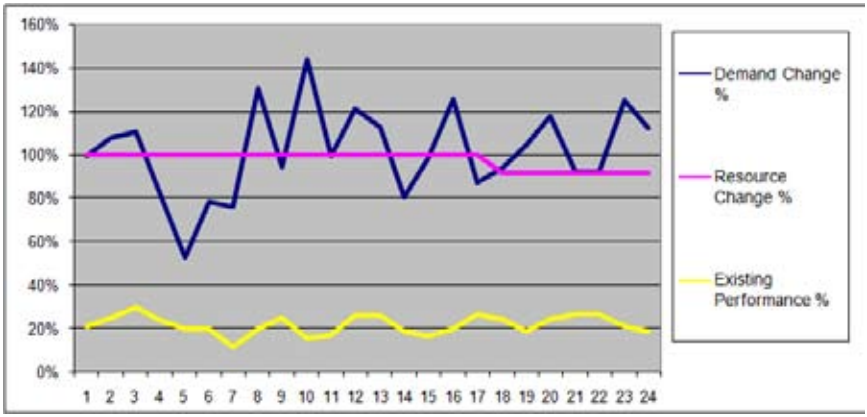
Thursday



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 routine patient transport work. The Mid-Western Ambulance Service knows that the absence of an intermediate care or PTS fleet 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.

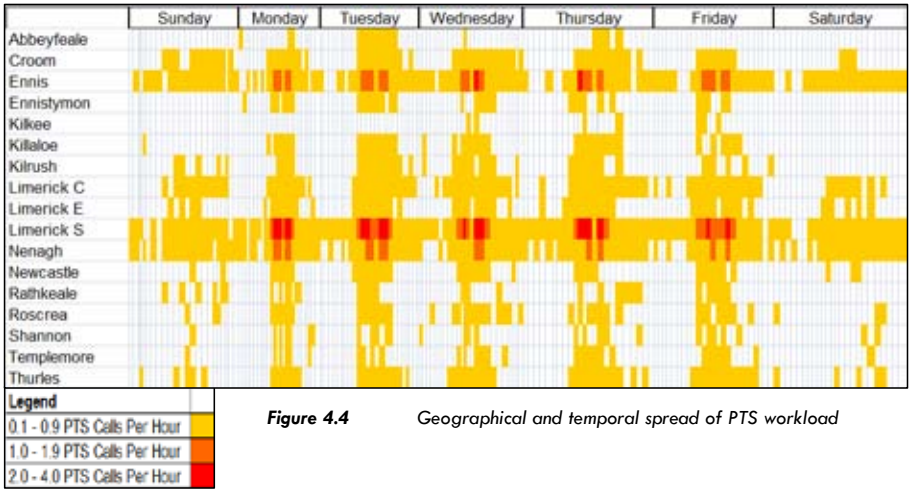


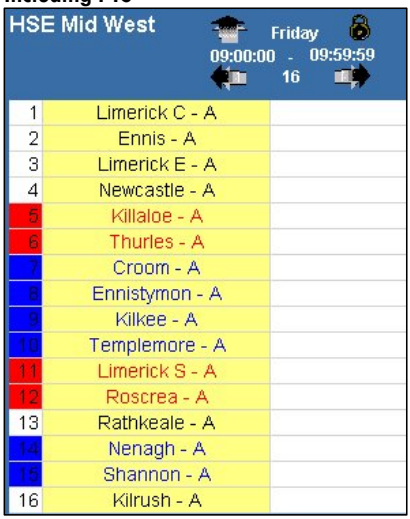
Figure 4.4 *Geographical and temporal spread of PTS workload*

This shows that Ennis, Limerick South and Nenagh have high PTS demand throughout the week. In some hours up to four PTS calls are being carried out, which means four less ambulances available to complete 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 Ennis, Limerick South and Nenagh, because the demand is higher than anywhere else.

Figure 4.5 is for Friday morning 09:00am – 09:59am. The screen shots of the TDP Viewer are the same whether PTS is included or excluded. The mobilisation dataset that is modelled in the TDP excludes calls where the "time mobile" field is blank in the dataset (which is consistent across the regional studies). As not all the PTS incident data includes a corresponding mobilisation record (i.e. with an entry in the "time mobile" field), we have not been able to model all PTS data through the TDP. Despite this on the basis of available records we consider performance forecasts have not been affected.

Including PTS



Excluding PTS

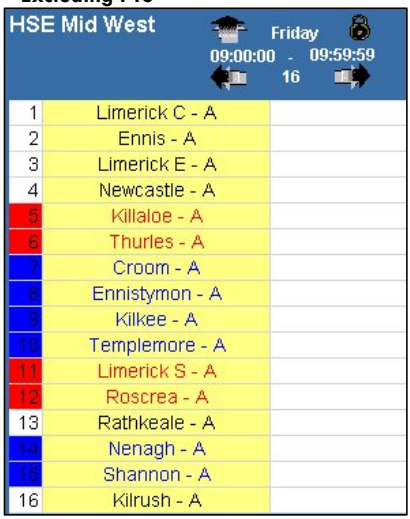


Figure 4.5 *Impact of PTS workload on the TDP*

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 three and three quarter 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 dictate an acute care transportation event. This means clear to clear times are reduced to an average of 74 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 only and the number of vehicles are not reduced due to vehicles off road, sickness, meal breaks etc.

4.5.1 Performance Forecasts

In the absence of any guidance as to current or future performance standards for the Mid-Western Region Ambulance Service, 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.

In the absence of segregation of MPDS codes or CBD codes, AS1 incidents are 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.

The table below shows the current and the forecast performance for the different scenarios as previously described, against a response standard of eight minutes for all Category 'A' incidents. With the current level of resources, the forecast performance in Scenario 3 is 70.5%. All of these forecasts assume an average of two minutes activation time.

Performance Dashboard

Daily Overall Performance		Existing Performance	Forecast Performance	Best Performance
	Sunday	29%	66%	88%
	Monday	26%	65%	85%
	Tuesday	26%	68%	86%
	Wednesday	29%	70%	87%
	Thursday	27%	74%	88%
	Friday	28%	71%	85%
	Saturday	26%	66%	84%
Monthly Overall Performance		27%	68.4%	86%

Figure 4.6 *Eight minute response time for AS1 incidents (current resource provision)*

Summary

- Implementing the TDP should improve responsiveness to emergency demand by around 40% points.
- If an intermediate care fleet was introduced to take care of all PTS workload, further percentage point increases in the number of AS1 calls responded to in eight minutes or less can be expected (c. 3 to 5%).
- Reducing the abstraction factor could move the ambulance service on by another 7.5% points.

4.5.2 Impact of Additional Vehicles

For each scenario we have calculated the predicted impact on performance of additional emergency ambulance resources. 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 86% 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. Estimates in this respect will only be possible on repeat of the TDP exercise for additional vehicles.

Summary
In Scenario 1 the vehicle could be either an ambulance or an intermediate care vehicle (ICV) which would 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%	1.3-1.5%	1.5-1.8%	0.9-1.3%

5. Demographic trends and service hierarchy implications.

The National Ambulance Service Mid-Western region consists of counties Limerick, Clare and North Tipperary. The region had a population of 361,028 in 2006. This represented a population increase of 6.3% from the 2002 figure of 339,591 persons. This section sets out the present and future population statistics and principal infrastructural provisions for the Mid-Western region. Relevant policy documents concern the National Development Plan 2007-2013, the National Spatial Strategy, the Regional Planning Guidelines for the Mid-Western region and the respective County Development Plans. Healthcare provision is maintained by the HSE and emergency care through the Mid-Western Ambulance Service. Overall there are six hospitals in the region, three of which are located in County Limerick and one in Limerick City namely; the Mid-Western Regional Hospital in Dooradoyle which functions as the main hospital for the region; St. John's Hospital in Limerick City; the Orthopaedic Hospital in Croom and St. Ita's Hospital in Newcastle West. The remaining are Ennis General Hospital, Clare; the Mid-Western Regional Hospital, Nenagh.

5.1 Demographic and Regional Trends

5.1.1 Context

The National Ambulance Service Mid-Western region is co-terminus with the Regional Planning Guidelines for the Mid-Western region in respect to its area. The region has a strong urban core consisting of Limerick City, Ennis and Shannon. Limerick City and Shannon enjoys the benefit of being defined as gateway city and Ennis is designated as a hub town in the National Spatial Strategy. They form an agglomeration that is almost centrally located within the region and hence is relatively easily accessed from all parts. The Shannon Tunnel will significantly enhance accessibility between south and west Limerick to Shannon and Ennis and expand their catchment. Shannon Airport is located herein and ensures that the region is of strategic national importance. The presence of University of Limerick and Limerick Institute of Technology makes the area a focus of population. However, some areas within the region are removed from the core and consist of weak urban structures – most notably in East Limerick and Northwest Clare. Here, the population is static or declining.

5.1.2 Population growth and projections

The region's population had modest growth between 2002 and 2006, principally centred on the catchment of Limerick City; however the city itself had the lowest level of growth compared to other major urban centres in the country.

In terms of individual county population patterns, between 2002 and 2006 the population of North Tipperary enjoyed the highest percentage growth rate at 8.2% where population increased from 61,010 in 2002 to 66,023 in 2006. County Clare showed the second largest population increase of 7.4 % during the inter-censal years with the population increasing from 103,227 in 2002 to 110,950 persons in 2006. Limerick County had a population increase of 5.0% (from 175,304 persons in 2002 to 184,055 persons in 2006); however the area of Limerick City under control of Limerick City Council (Borough) showed a population decline of -2.7% during the same period.

The largest proportion of population located in aggregate town areas (town with population in excess of 1,000 persons) is based in County Limerick[2]. In 2006, approximately 51.9% of the

[2] Aggregate Town Areas are defined as those settlements with a population of 1,500 and over.

population was located in town locations. This is in contrast with North Tipperary where only 37.3% of the population is in town locations and County Clare where the figure stands at 39.1%. The State average stands at 60.7%. The region can therefore be largely defined as being rural in character. Rural areas have largely dissimilar infrastructural requirements than their urban counterparts and therefore the fact that the Mid-Western region is largely rural will impact upon infrastructural provision.

The dependency rates for the respective counties are largely similar. Dependency is defined as that proportion of the population under the age of 15 (minors) and those aged 65 years (retirement age) and over. North Tipperary has a dependency rate of 34.1%; the highest in the region. This is closely followed by county Clare whose dependency rate stands at 33.3%. County Limerick has an overall rate of 30.5% with the county having a dependency rate of 30.6% and a rate of 30.2% prevailing in Limerick City. These figures are largely in line with the state dependency rate of 31.4%. The greater the dependency rate, the greater the implications for healthcare provision. This is especially true in the case of older dependents.

Table 5.1 *Regional Populations Forecasts*

Mid West Region	Total Population		% of State Population		Dependency Ratio (2006)
	2002	2006	2002	2006	
Clare	103,277	110,950	2.6%	2.6%	*33.3%*
Limerick City	54,023	52,539	1.4%	1.2%	*30.6%*
Limerick County	121,281	131,516	3.1%	3.1%	*30.2%*
Tipperary North	61,010	66,023	1.6%	1.6%	*34.1%*
Region Total	**339,591**	**361,028**	**8.7%**	**8.5%**	***31.5%***

Source: CSO 2005, Mid-Western Regional Planning Guidelines

The CSO Regional Population Projections 2006-2021 project that the population of old persons (defined as those aged 65 and over) will increase in every region in the country. The very old population (defined as those aged 80 years and over) is projected to increase by two-thirds by 2021. In relation to the Mid-Western region in particular, it is considered that the old dependency ratio will increase by 25.1%. The changing age profile of the population of this region will mean that policies relating to healthcare provision must be tailored to accommodate this. This will put extra demands for both emergency care provision and patient transport.

The Regional Planning Guidelines (RPG) for the Mid-Western region are preparing for a maximum target population of 400,000 by 2020. This reflects the projected impact of the National Spatial Strategy (NSS), especially Limerick City's designation as the 'Gateway City' within the region. Aside from this, given that the region is home to an international airport, two universities and the Shannon Development Free Zone; policy documents are optimistic for future growth. The RPGs are aiming to facilitate this growth in developing a number of growth nodes with the gateway acting as the principal catalyst for the region. A notable feature of the projections is the decline in the population share of the Mid-Western region of the projected state population, with a reduction of around 0.4 percentage points from current share (see table 5.2).

The county development plans do not provide any localised projections that can indicate the likely location of population growth within an individual county. 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, within towns and urban areas in particular the Limerick City environs, Shannon/Ennis, Croom, Nenagh Newcastle West and the smaller west Limerick towns of Adare and Patrickswell.

Table 5.2 *Regional Population Projections*

Mid West Region	Year 2021		2020
	CSO MIF2 (Recent)	CSO M1F2 (Medium)	Regional Planning Guidelines Target
Mid West (000's)	411	410	400
% of State Population	8.11%	8.09%	7.97%

Source: *CSO & Mid West Regional Planning Guidelines*

5.1.3 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 towards more urbanised growth areas, in particular around Limerick City. This is likely to be further exacerbated by ageing population trends in rural areas.

5.2 Policy Documents

National Spatial Strategy:

The National Spatial Strategy (NSS) states that although the Limerick/Shannon Gateway and the Ennis Hub will be the main drivers for the region, it is essential that towns such as Nenagh, Thurles and Newcastle West are provided with appropriate policies and actions to support their roles in driving development in the region. These towns were chosen based on the fact that their populations are of at least 5,000 persons. Policies on good urban design, environmental quality and effective linkages to the gateway should be devised. Towns with populations under 1,500 persons such as Abbeyfeale, Kilrush, Rathkeale, Roscrea and Templemore have, according to the NSS opportunities to improve their base for enterprise, housing and other functions within the county structure, in partnership with larger towns. These towns offer viable options for locating certain infrastructure centres such as healthcare facilities, out-patient facilities, nursing homes etc.

National Development Plan 2007-2013:

The National Development Plan (NDP) 2007-2013 states that Ireland came 22nd out of 28 countries in relation to overall quality of infrastructure. This ranking although based on people's perceptions is indicative of the poor levels of provision and leads NDP to state that investment in economic and social infrastructure is critical to maintaining a national competitiveness. The NDP specifically prioritises the provision of social infrastructure including;

- Enhancing the hospital infrastructure, and
- Enhancing primary, community and continuing care facilities, particularly for older persons.

Balanced regional development is a main policy of the NDP and the Mid West Regional Planning Guidelines provide that the Mid-Western region has the capacity to be a future counter-force of Dublin.

Infrastructure priorities for the Mid-Western region include the completion of the M/N 7 Dublin/Limerick Motorway by 2010 together with the completion of Phase II of the Southern Ring

Road (including the Shannon Tunnel) and the N69 route to Tralee. Improving rail facilities from Limerick to Dublin is also a main priority.

The NDP states that challenges in the provision of social infrastructure are likely to arise due to increasing longevity of life and an increasing population of persons with disabilities as a result of reducing mortality from serious illness. The disparities in regards to access to healthcare must also be addressed given the difficulties encountered by certain income categories and certain ethnic groups.

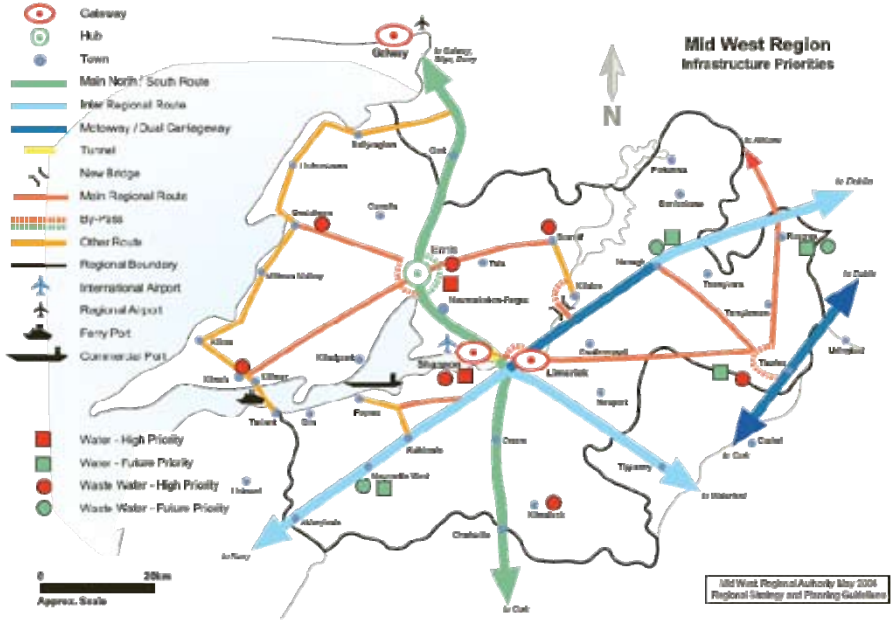
The Mid West Regional Authority Regional Planning Guidelines:
The Mid West Regional Planning Guidelines anticipate a population growth to 400,000 persons by 2020. Initially a population of 380,000 was projected but this figure was revised to take account of the National Spatial Strategy. In relation to this population location, the guidelines provide that;

- The creation of a regional core area with critical mass must be assured.
- Other service centres must be facilitated or created.
- The population of rural areas must be sustained.
- Environmental quality must be assured.
- Public transport linkages must be provided to the main centres.

The Limerick/Ennis/Shannon corridor is noted as the main growth corridor for the region. The spatial distribution of population and economic growth is unbalanced with only two towns of populations of over 5,000 outside of the core area. Many other towns that grew significantly during inter-censal periods were within the core area's influence. Other towns showed population decline during the years 1996-2002; although the population loss was noted as being relatively small.

The guidelines note that there has been significant growth in the amount of traffic generated in the region. Growth rates have been highest in the outer suburbs of Limerick. The Limerick/Cork road showed the highest level of growth, doubling in traffic during the years 1996 to 2002. In relation to healthcare, the RPGs note that the population of those under 15 and those over 80 growing. Projections indicate that this trend is set to continue. This will have implications for the provision of services for the elderly, particularly the very elderly. Also, approximately one-quarter of old persons live alone. Deprivation indicators have shown that the highest level prevails in Limerick city. This highlights the area within the region that may require additional health service provision. The guidelines also provide that the primary causes of premature mortality are cancer, cardiovascular disease and accidents. Death rates have been steadily declining over the last 15 years and were previously much higher than the national average. The rates have been approaching the national average in recent years.

Figure 5.1 *Mid West Regional Planning Strategy*



(extract from Mid West Regional Planning Guidelines 2004)

Clare County Development Plan 2005-2011

The County Development Plan recognises Ennis as a strategic county town; however, it states that in regional terms, Shannon plays a greater role. Towns like Kilrush, Ennistymon, Scarriff and Killaloe act as focuses of growth for their surrounding rural hinterland. The plan recognises that many areas within the county are not within one hour (drive) access of a primary healthcare facility. The identification of such sites will be done in Local Area Plans. The plan states that the future for provision of healthcare services will be through the establishment of primary care centres where access to a range of services will be provided. Such services include GPs; nurses/midwives; healthcare assistants; home-help; physiotherapists; occupational therapists; social workers and administrative personnel. Primary care teams are to be brought together to serve small population groups of between 3,000 and 7,000 people depending on whether the region is rural or urban.

Limerick County Development Plan 2005-2011

The population of County Limerick increased by 7.3% between the years 1996 and 2002. This was a population increase from 113,003 persons to 121,281 persons. Two Electoral Divisions, namely Ballysimon and Ballycummin accounted for 60% of this population increase. This spatial imbalance of population will impact on service provision contrasting with the need to ensure equitable access throughout the Mid-Western region. The number of young children and elderly persons are set to increase in the county, impacting on service provision once more, especially services for the elderly. The County Council has a policy to accommodate, where appropriate, the provision of nursing homes and sheltered housing developments in rural areas to help address this.

The plan states that these services should be located within settlement boundaries in order to enhance the overall quality of life. The Council also has a policy to accommodate emergency services in locations that facilitate ease of access and safe functioning with respect to the road network.

North Tipperary County Development Plan 2004-2010

North Tipperary is a predominantly rural area with 60% of the population residing in rural locations. The area has a weak urban structure and the population density is particularly low with only 30 persons per square kilometre. There are 4 main towns in North Tipperary namely, Thurles, Nenagh, Roscrea and Templemore. These main agglomerations account for just fewer than 40% of the population of the county with Thurles and Nenagh collectively accounting for 21%. Given the high rural population together with the fact that a survey carried out by the County Development Board portrayed that almost 4000 rural persons have an unmet demand for good rural transport, service provision is a main policy aim going forward.

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 can add to the development of certain areas and the provision of routes in the Mid West in the immediate future will prove vital to its progression and indeed its overall sustainability. The following road schemes are underway in the various counties of the Mid-Western region.

County Clare

Scheme	Status	Start County	End County
N7 Limerick Tunnel (LSRR Phase 2)	Construction	Limerick	Clare
N18 Gort to Crusheen	Tender	Galway	Clare
N18 Ennis Bypass	Complete	Clare	Clare

County Limerick

Scheme	Status	Start County	End County
N7 Limerick Tunnel (LSRR Phase 2)	Construction	Limerick	Clare
N7 Nenagh Limerick	Construction	Limerick	Tipperary
N7 Limerick Southern Ring Road Phase 1	Complete	Limerick	Limerick
N20 Croom to Patrickswell	Constraints Study	Limerick	Limerick
N20 Mallow to Croom	Preliminary Design	Cork	Limerick
N21 Adare Bypass	Preliminary Design	Limerick	Limerick
N21 Abbeyfeale to Adare	Route Selection	Limerick	Limerick
N21 Castleisland to Abbeyfeale	Complete	Kerry	Limerick

Scheme	Status	Start County	End County
N24 Ballysimon to Pallasgreen	Constraints Study	Limerick	Limerick
N24 Pallasgreen to Bansha (Western Corridor)	Preliminary Design	Limerick	Tipperary

North Tipperary County

Scheme	Status	Start County	End County
N7 Nenagh Limerick	Construction	Limerick	Tipperary
N8 Cashel Mitchelstown	Construction	Tipperary	Cork
M8/N8 Cullahill to Cashel	Construction	Tipperary	Laois
N24 Carrick on Suir Bypass	Preliminary Design	Tipperary	Tipperary
N24 Pallasgreen to Bansha (Western Corridor)	Preliminary Design	Limerick	Tipperary
N62 Roscrea Bypass	Constraints Study	Tipperary	Tipperary
N62 Horse and Jockey/ Thurles Bypass	Constraints Study	Tipperary	Tipperary

5.3 Development Trends Summary

The Mid-Western region of Ireland is a predominantly rural region and therefore requires tailored policies in regard to its future planning and emergency care provision. The isolation of West Clare, the spatial imbalance of County Limerick's population and the dispersed nature of the population of North Tipperary all present challenges for healthcare providers. It is vital that such services are located in areas of critical mass to ensure economic viability, but the rural population must be able to reach such emergency services. This challenge must be assessed with both economic sustainability and the 'golden hour' in mind.

The ageing population of the region, especially the predicted growth of the very old (i.e. those aged 80 years +) will present new challenges regarding care for the elderly. Improvement in the quality of such care will be necessary. Overall, the provision of equitable and sustainable healthcare services in the Mid-Western region will undoubtedly pose a number of challenges. The continuing improvements in the road infrastructure together with increasing communication technologies will be of benefit.

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 was apparent. A similar Spatial Typology was adopted, similar techniques in respect to assessing response times and a similar methodology for the Tactical Deployment Plan.

The use of Tactical Deployment Plan (TDP) in the study has extended its scope to embrace not only a research agenda but also the operational context of service delivery in the National Ambulance Service Mid-Western region. The TDP demonstrates how 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 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 will be presented to ambulance staff in the Mid-Western 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 for emergency services occur, 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 ambulance service regions, but also progress the potential enhancements to the ambulance services in the Mid-Western 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 national ambulance service regions. Extension of the analysis to other 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. The findings in this study demonstrate the operational imperative of maintaining support for the MPDS implementation into the ambulance services and that this should apply ProQA (or equivalent) standards in order to allow quantification of life threatening incidents. 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 benefits for enhanced responsiveness to emergency incidents in the Mid-Western region. 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 Mid-Western region, these are;

R5) Revision of TDP:

Given the rate of population growth, change in the demographic age structure, ongoing urban growth and changes in infrastructure updated TDP exercises will be required for the Mid-Western region 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) Addressing future demands

The analysis has demonstrated that high demand arises in urban centres, continued strong population growth is expected in the principal urban centres and provision of future resources should be aligned to equitably address this growth. The TDP highlighted increased requirements for additional response origins in Limerick City and in the growing settlements around Limerick, most notable at Shannon town. In parallel the areas of lower population, in particular in North East Clare require fewer response

origins. While inter-regional analysis may prove that existing facilities in adjoining centres will provide a wider inter-regional service, of particular note in this regard is Roscrea and the settlements in East Limerick.

R8) Patient Transport Service & Inter-agency consultation:

Provision of PTS in the Mid-Western 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 ambulances 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.

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