Demand Analysis and Tactical Deployment of Ambulance Services in the National Ambulance Service North-Eastern 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 coordinated 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 North West region. These studies are the first of their kind in the Republic of Ireland in that it utilises detailed ambulance service records to firstly, assess both demand for and past performance of ambulance emergency care, and secondly; make recommendations on how the spatial configuration of services may be improved to achieve enhanced ambulance services in the region. Current and future trends are also examined.

The project has two parallel functions; firstly to provide recommendations on the spatial configuration of ambulance resources in the National Ambulance Service North-Eastern 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 North-Eastern region.

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

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

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

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

Team Approach

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

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

Study Period and Data Collection

Data for the study was supplied by the ambulance service of National Ambulance Service North-Eastern 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 corresponds to the most recent census year in 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. Other patient transport services that utilise taxi services are not captured digitally.

Report Structure

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

Acknowledgements

We would like to acknowledge the support of Dr Geoff King and the staff in the Pre-Hospital Emergency Care Council for their support in undertaking this project. Mr Frank McClintock, Assistant National Director of the National Hospitals Office initiated the study and was instrumental in its direction. We would also like to thank Patrick Grant, Chief Ambulance Officer, National Ambulance Service North-Eastern 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), doctors urgent calls (AS2) and routine transport calls (AS3) 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 North-Eastern Ambulance Service. The ambulance service in this region operates a Medical Priority Despatch System (MPDS). The system operator creates a new record for an incident upon receipt of a call from either one of a variety of sources including the general public on the 999 call system, individual 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 North-Eastern 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 under populated areas. The operator can select to assign the incident to the suggested location or establish the location 'by hand' through reading digital map displays. An assessment of the locational accuracy in the data audit of the data indicated minimal errors in data position and none that would materially affect the results of the study.

Amended Incident Types;
At the data audit stage of the study it became apparent that a number of incidents (c. 1500) had been incorrectly classified as AS1. These were all located in and around hospitals and were discovered to be AS2 incidents that involved urgent transport of patients from hospitals. These were re-classed in the final database.

Incident Numbers;
The total number of AS1 and AS2 calls recorded was 20,170. A number of incidents were 'stood down' either before or after resources were assigned or sometimes after a resource had reached the location of an incident. In general all incidents where the ambulance(s) have reached the scene are considered in all aspects of the study and are identified in table 2.2 as 'unique responded incidents with location'; there were 13.204 AS1 and 5,391 AS2 such incidents in the North-Eastern 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. A small number of incident records included either no 'at scene' time or had 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 appears 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

AS1 & AS2 Incidents in NE Region			
Incident Type	**Emergency AS1**	**Doctors Urgent AS2**	**Total**
Unique Responded Incidents with Location	**13,204**	**5,391**	**18,595**
'Stood Down' before 'At Scene Time'	899	51	950
'Stood Down' unspecified Location	40	6	46
No 'At Scene' time	22	87	109
Unspecified Location	186	284	470
Number of Incidents	**14,351**	**5,819**	**20,170**

2.2 Temporal Variability

The demand profile for AS1 and AS2 calls received in the North-Eastern 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	1,089	487	1,576	35	16	51
February	1,122	485	1,607	40	17	57
March	1,166	505	1,671	38	16	54
April	1,115	449	1,564	37	15	52
May	1,222	506	1,728	39	16	56
June	1,191	455	1,646	40	15	55
July	1,272	451	1,723	41	15	56
August	1,271	499	1,770	41	16	57
September	1,189	481	1,670	40	16	56
October	1,222	517	1,739	39	17	56
November	1,090	467	1,557	36	16	52
December	1,402	517	1,919	45	17	62
Total	**14,351**	**5,819**	**20,170**	**39**	**16**	**55**
Average Monthly	***1,196***	***485***	***1,681***			

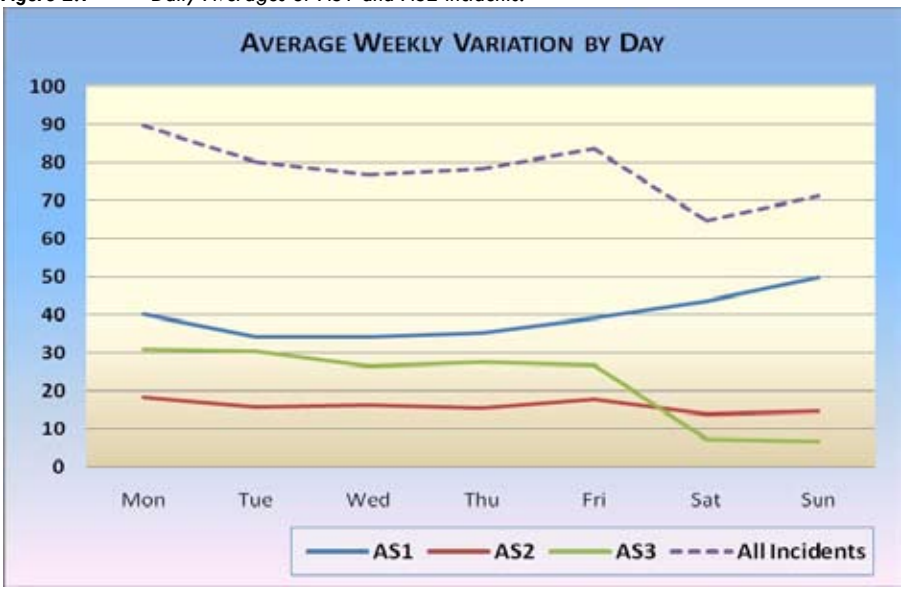
Within the region the average monthly rate for AS1 incidents was 1,196 per month and 485 for AS2 incidents. December had the highest number of incidents of any individual month; December also has the highest daily average of any month for AS1 calls with a daily average of 45 per day. This is significantly higher than the annual daily 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, on December 24th 70 AS1 incidents were recorded. In contrast the months of November and January had the lowest absolute numbers of AS1 incidents and the lowest daily rates.

2.2.2 Weekly Variation

Incident rates across the week in the North East are broadly static during week days but show a distinct increase in AS1 activity at the weekends and in contrast a strong reduction in demand for AS3 services, matched to a lesser degree by a small reduction in AS2 activity (see figure 2.1)

The busiest day is Monday; this is mainly due to high levels of AS1 associated with weekend activities in the early hours of Monday mornings, but also in increased demand for AS2 and AS3 services.

Figure 2.1 *Daily Averages of AS1 and AS2 incidents.*



2.2.3 Daily Variation

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

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

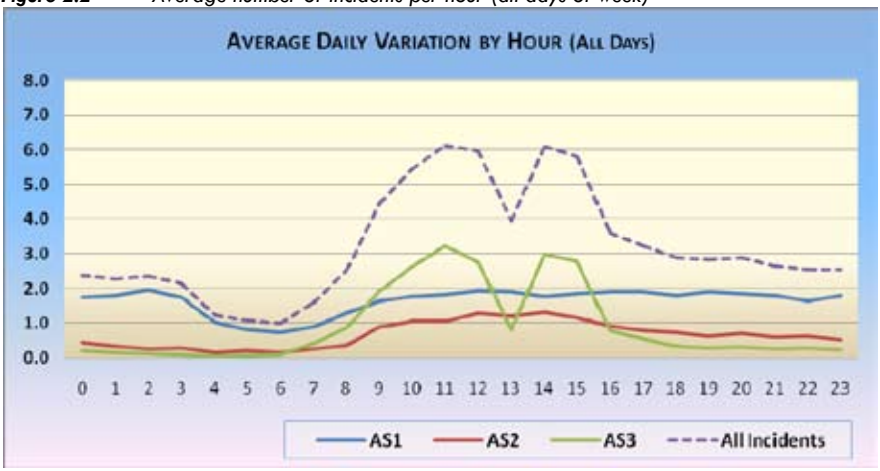


Table 2.4

Average Daily Variation by Hour (All Days)				
Hours	**AS1**	**AS2**	**AS3**	**All Incidents**
Ave. 08.00 to 18.59	*1.8*	*1.0*	*1.8*	*4.5*
Ave. 19.00 to 07.59	*1.5*	*0.4*	*0.2*	*2.1*
Average Hourly	**1.6**	**0.7**	**0.9**	**3.2**
Total Daily Average	*39*	*16*	*22*	*78*

As already noted there are different incident rates during weekend hours compared to weekdays, for this reason figures 2.3, 2.4 and 2.5 examine incident rates for hours during the weekend, during weekdays and on Mondays alone.

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

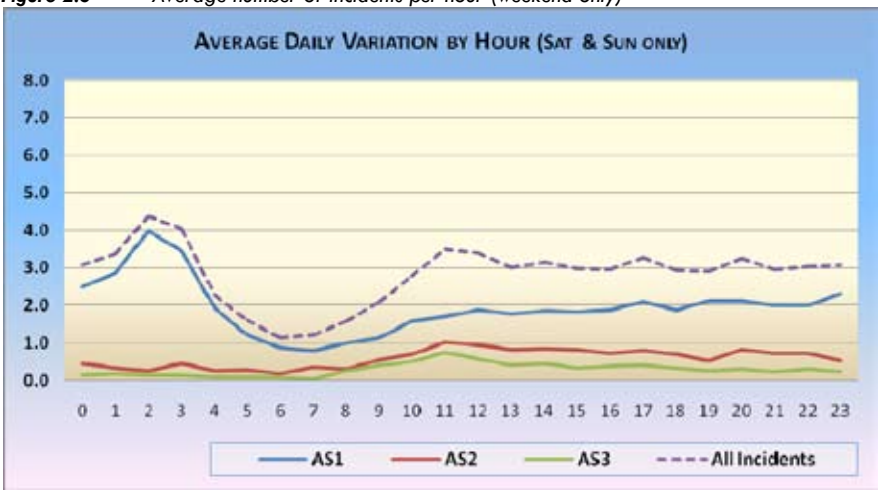


Table 2.5

Average Daily Variation by Hour (Sat & Sun only)				
Hours	**AS1**	**AS2**	**AS3**	**All Incidents**
Ave. 08.00 to 18.59	*1.7*	*0.8*	*0.4*	*2.9*
Ave. 19.00 to 07.59	*2.2*	*0.5*	*0.2*	*2.8*
Average Hourly	**1.9**	**0.6**	**0.3**	**2.8**
Total Daily Average	*47*	*14*	*7*	*68*

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

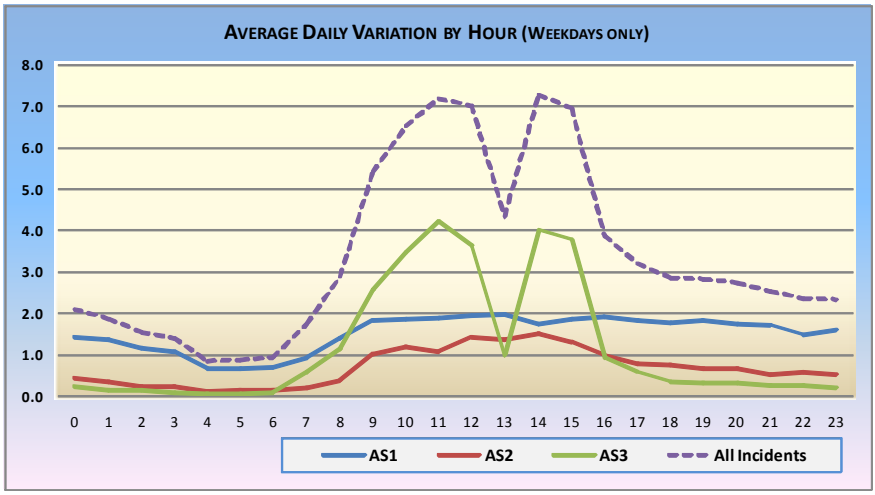


Table 2.6

Average Daily Variation by Hour (Weekdays only)				
Hours	**AS1**	**AS2**	**AS3**	**All Incidents**
Ave. 08.00 to 18.59	*1.8*	*1.1*	*2.3*	*5.2*
Ave. 19.00 to 07.59	*1.3*	*0.4*	*0.2*	*1.8*
Average Hourly	**1.5**	**0.7**	**1.2**	**3.4**
Total Daily Average	*36*	*17*	*28*	*81*

At weekends demand on ambulance services from AS1 activity increases while there is a corresponding decrease in AS2 and AS3 demand. The average hourly demand at the weekend is 1.9 AS1 incidents per hour is compared to the 1.5 per hour for weekdays only. The average hourly rate of AS3 on Saturdays and Sundays is 0.3 compared to 1.2 per hour for weekdays (see tables 2.5 and 2.6).

The period 23.00hrs to 04.00hrs on weekend nights and the early hours of Mondays (see table 2.7) are the busiest times for AS1 activity with call rates approaching an average of 4 per hour at around 02.00hrs. Day time demand for AS1 services is also slightly higher at weekends and the steady increase in activity during the day and early evening is a notable feature of the time profile.

Weekend rates of AS2 and AS3 are significantly lower than during weekdays with Mondays having the highest rates. Between 08:00hrs to 18:59hrs the average hourly rates of AS3 incidents are 2.5 and of AS2 incidents 1.2 thus when combined with AS1 activity for this period gives an average hourly rate for all incidents of 5.6 per hour (see table 2.7), confirming Mondays as the ambulance service's busiest day.

Figure 2.5 *Average number of incidents per hour (Mondays only)*

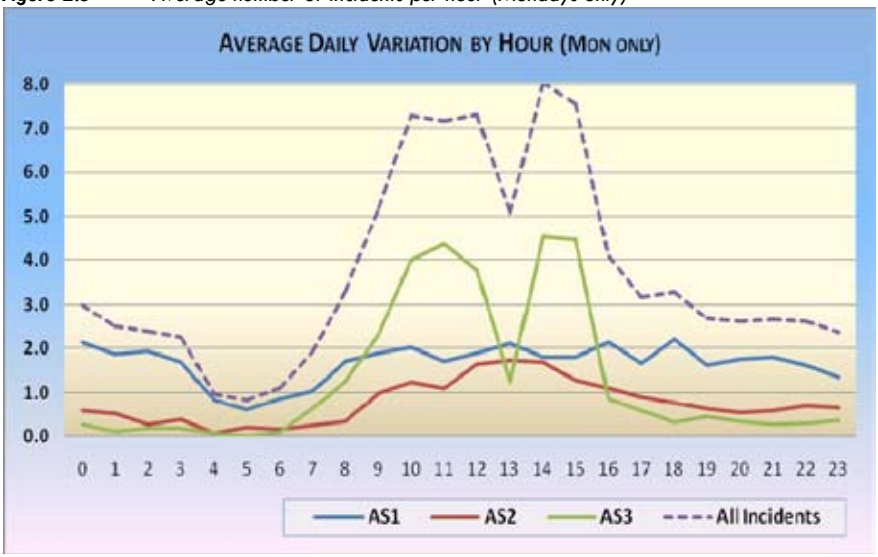


Table 2.7

Average Daily Variation by Hour (Mon only)				
Hours	**AS1**	**AS2**	**AS3**	**All Incidents**
Ave. 08.00 to 18.59	*1.9*	*1.2*	*2.5*	*5.6*
Ave. 19.00 to 07.59	*1.5*	*0.4*	*0.2*	*2.1*
Average Hourly	**1.7**	**0.8**	**1.3**	**3.7**
Total Daily Average	*40*	*18*	*31*	*89*

2.2.4 Temporal Variation Findings

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

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

- Significant variation of demand activity occurred between weekends and weekdays. The weekly profile of demand demonstrated that AS1 calls increased over weekends, but rates of AS2 and AS3 incidents reduced to very low numbers, especially in the case of AS3 call activity. On weekdays AS2 and AS3 calls showed highest levels of demand on Mondays.

- During the day two demand peaks are apparent on weekdays, firstly between 11.00hrs to 12.00hrs and between 14.00hrs to 15.00hrs, this is primarily driven by AS3 call activity, which drops to very low levels at 13.00hrs (lunchtime). Call rates for AS1 and AS2 incidents do not display any particular change at this time however.

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

- Highest hourly rates occur on Mondays with particularly high rates of AS2 and AS3 activity, however in the early hours of Monday morning, 00.00hrs to 03.00hrs, AS1 activity remains relatively high.

2.3 Incident Types

The capture of incident types is made within the North-Eastern Computer Aided Despatch System, (MIS) against a standard set of MPDS codes. The fifteen most frequently occurring 'MPDS chief complaint' for AS1 incidents has been extracted from the records and display as a daily rate for weekdays and weekends in table 2.8.

Table 2.8 *AS1 MPDS Chief Complaint*

Rank	MPDS Chief Complaint	Average Number of Incidents Per Day		% of All Incident
		Mon to Fri	Sat to Sun	
1	Unknown Problem - Collapse-3rd Pty	5.2	6.2	14%
2	Falls/Back Injuries - Traumatic	4.3	5.6	12%
3	Sick Person - Specific Diagnosis	3.3	4.6	9%
4	Traffic Accidents - RTA	3.4	4.0	9%
5	Chest Pain	3.1	3.0	8%
6	Breathing Problems	2.7	2.8	7%
7	Unknown	2.4	3.0	7%
8	Convulsions/Fitting	1.8	2.4	5%
9	Assault/Rape	0.9	3.8	5%
10	Abdominal Injury/Pain	1.6	1.6	4%
11	Overdose/Ingestion/Poisoning	1.3	1.7	4%
12	Pregnancy/Childbirth/Miscarriage	0.9	1.8	3%
13	Traumatic Injuries, Specific	1.1	1.2	3%
14	Haemorrhage/Lacerations	0.9	1.5	3%
15	Psychiatric/Suicide Attempt	0.4	0.5	1%
	Other MPDS Codes	2.6	2.4	7%
	AS1 Incidents	**36**	**47**	**100%**

The most commonly recorded incident type at 14% of all AS1 incidents (1,994 incidents) is the '*Unknown Problem – Collapse 3rd Party*' reflecting the absence of detailed information available to the ambulance service from 999 calls. Daily rates are consistently higher at the weekend except for 'chest pain' category where slightly higher average daily rates are apparent. The category with the greatest relative difference between rates at the weekend is the 'assault/rape' category, where an average daily rate of 0.9 occurred on weekdays and 3.8 at weekends.

Thus results provided in table 2.8 can only be considered as a broad indicator of the types of incidents that the ambulance service in the North-Eastern region respond to and additional recording protocols are required to ensure that this information has clinical value to allow any conclusions to be drawn from it.

2.4 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.

2.4.1 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 5000 persons) consisting of;

Drogheda	Dundalk	Ratoath	Monaghan
Ashbourne	Navan	Trim	Cavan

  Note: Laytown/Bettystown is a dispersed town and is not included as a town of greater than 5000 persons

- Towns with population in 2006 of over 1,000 persons *(these towns have full listing of census variables in the CSO Small Area Population Statistics for the region)*
- Rural areas (population density greater then 10 persons per Km^2)
- Sparsely populated areas (population density of less than 10 Persons per Km^2).

Figure 2.6 *Settlements and current distribution of ambulance stations*

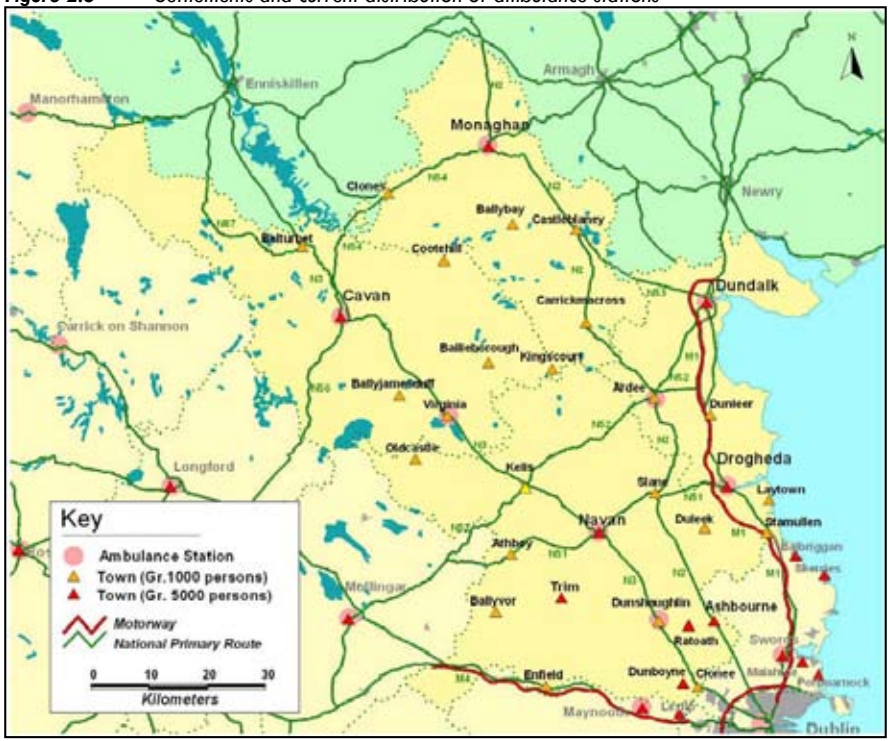
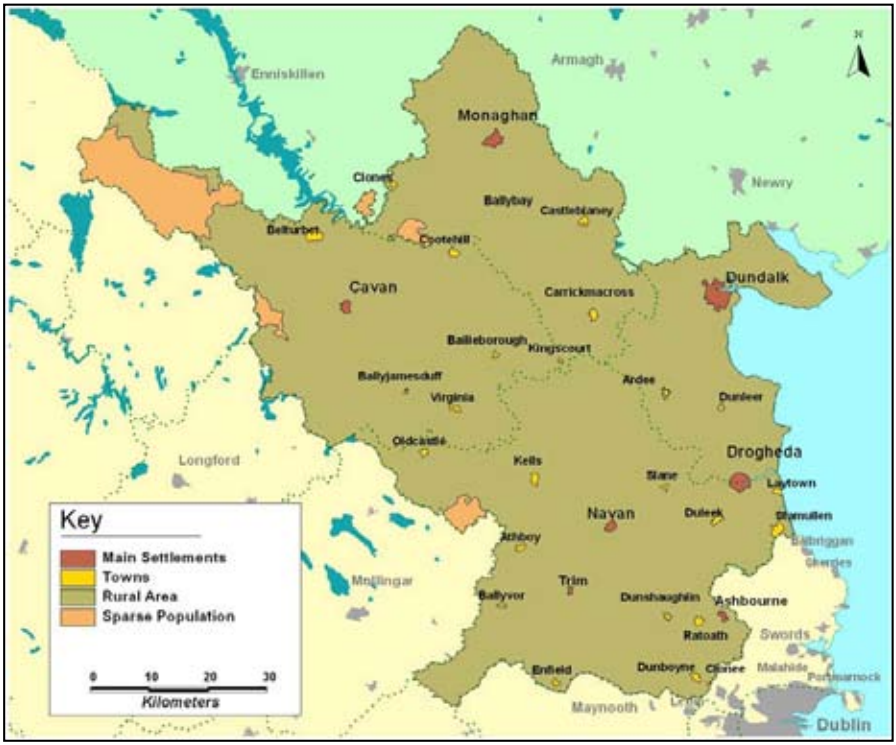


Figure 2.7 *Spatial Typology*

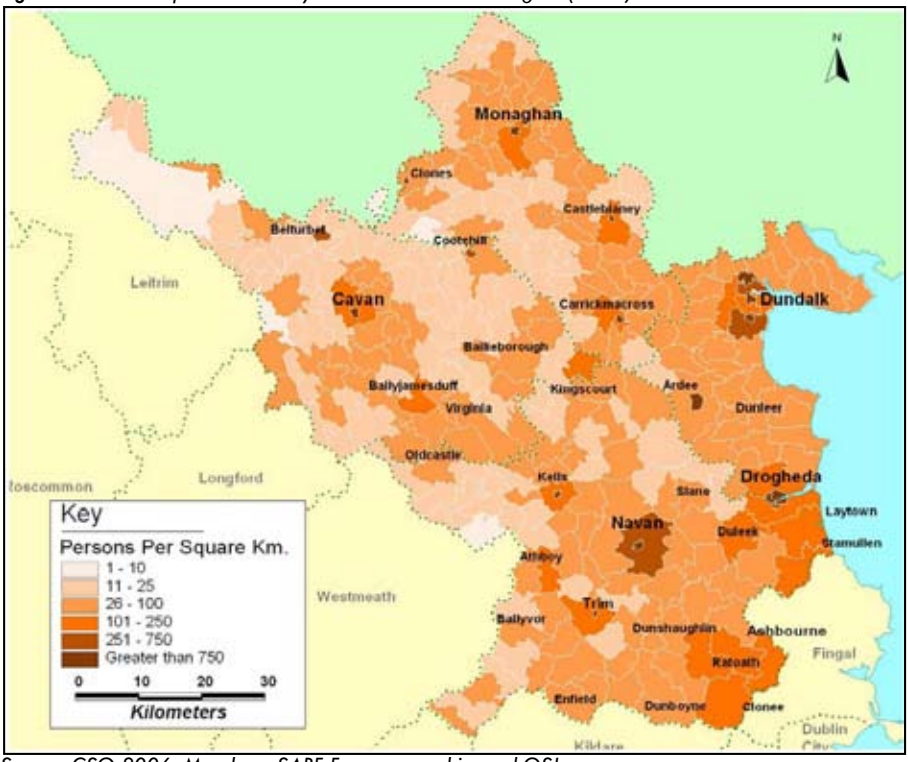


Source: SABE Eurogeographics, OSI and Spatial Planning Solutions Ltd.

In population terms the most current census in 2006 indicated that the entire region had a population of 394,098 persons. From 2002 to 2006 the population of the region increased by 14.2% (see table 2.7), considerably above the national average of 8%. Population growth was strongest in the towns with an increase of 19.9% compared to rural areas with an increase of around 10.5%. County Meath towns had very strong growth where an increase of 37.5% represented an increase of 21,200 in the four year period. The strengthening of the urban population base in the region corresponds to national trends and has important implications for future emergency care provision.

The population density map in figure 2.8 highlights the distribution of population in the region. The majority of the population is located along the coastal corridor from Dublin to Dundalk and then continuing towards Monaghan. Higher densities are concentrated along the principal transport corridors with clear linear patterns on the N3, N2 and M1. The high population densities around Ratoath and Ashbourne are a product of recent strong population growth.

Figure 2.8 *Population Density in the North-Eastern Region (2006)*



Source: CSO 2006. Map base SABE Eurogeographics and OSI

2.4.2 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 *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				
Louth						
Towns & Villages	66,354	71,531	7.8%	4,885	6.8	5.2
Rural Areas	35,467	39,736	12.0%	1,796	4.5	3.3
Low Density Rural Area	-	-		-	-	-
Total	101,821	111,267	9.3%	6,681	6.0	4.5
Meath						
Towns & Villages	62,199	85,545	37.5%	3,529	4.1	3.0
Rural Areas	71,576	77,059	7.7%	3,027	3.9	2.9
Low Density Rural Area	230	227	-1.3%	-	-	-
Total	134,005	162,831	21.5%	6,556	4.0	2.9
Cavan						
Towns & Villages	13,694	17,439	27.3%	1,541	8.8	5.6
Rural Areas	41,410	45,118	9.0%	1,471	3.3	2.0
Low Density Rural Area	1,442	1,446	0.3%	9	0.6	0.3
Total	56,546	64,003	13.2%	3,021	4.7	3.0
Monaghan						
Towns & Villages	11,333	12,022	6.1%	1,478	12.3	7.8
Rural Areas	40,984	43,713	6.7%	785	1.8	1.2
Low Density Rural Area	276	262	-5.1%	4	1.5	0.8
Total	52,593	55,997	6.5%	2,267	4.0	2.6
NE Region						
Towns & Villages	153,580	186,537	21.5%	11,433	6.1	4.4
Rural Areas	189,437	205,626	8.5%	7,079	3.4	2.4
Low Density Rural Area	1,948	1,935	-0.7%	13	0.7	0.4
Total	**344,965**	**394,098**	**14.2%**	**18,525**	**4.7**	**3.3**

The results indicate average rates of incidents per head on population, where for the region as a whole there were 4.7 incidents per 100 persons, this is made up of 3.3 AS1 incidents per 100 persons with the residual, 1.4, being the number of AS2 incidents per 100 persons.

The key feature from this analysis is that rates of AS1 and AS2 per capita are significantly higher in urban areas compared to rural areas. Thus for example there were 5.2 AS1 incidents per 100 persons in Louth towns compared with 3.3 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.

Towns in Monaghan had the highest rates for AS1 incidents at 7.8 per 100 persons, Cavan also had higher than average call rates per head of population. Meath had significantly lower rates for urban areas, but slightly higher rates than rates for rural areas. This may be partly explained

by the nature of settlement in the area, in particular where dispersed settlement in smaller villages around south Meath has occurred. However given that the county average at 4.0 AS1 incidents per 100 persons is the lowest incident rate relative to population (County Monaghan also 4.0) suggests that additional factors in terms of Meath's call rates should be considered. In particular that some of the demand for ambulance services in Meath, especially near the County Dublin border areas is being met by ambulance services from the Eastern region.

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 1000 persons in 2006). The table also highlights main settlements where population is greater than 5,000 persons. The towns of Meath show some of the highest population increases for the whole country with Stamullen, Ratoath, Enfield and Clonee increasing population by over 90% between 2002 and 2006.

There is considerable variation in the levels of incidents that were responded to by the North-Eastern Ambulance Service. Established large towns such as Dundalk and Drogheda had rates of 6.0 and 4.5 AS1 incidents per 100 persons, while other large towns, notably Navan had significantly lower rates. The more isolated towns in Monaghan and Cavan had the highest rates with Monaghan and Cavan town having 8.3 and 10.6 incidents per 100 persons respectively. The rapidly growing towns around south Meath had some of the lowest rates. It is postulated that this may arise from use of resources from the adjoining regions; analysis of data from the Eastern region will confirm this.

Table 2.10 *Urban Population and AS1 & AS2 incident rates in North-Eastern Region*

Co.	Town *(population greater than 1,000)*	Total Population		% Change	AS1 & AS2 Incidents		AS1	
		2002	2006		No.	Per 100 Persons	No.	Per 100 Persons
Louth	Dundalk	32,505	35,085	8%	2,711	7.7	2,094	6.0
	Drogheda	28,887	30,303	5%	1,822	6.0	1,378	4.5
	Ardee	3,948	4,694	19%	319	6.8	221	4.7
	Dunleer	1,014	1,449	43%	73	5.0	51	3.5
	Total Co. Louth	**66,354**	**71,531**	**8%**	**4,925**	**6.9**	**3,744**	**5.2**
Meath	Navan	19,417	24,851	28%	1,044	4.2	628	2.5
	Laytown Bettystown [1]	5,597	8,978	60%	275	3.1	214	2.4
	Ashbourne	6,362	8,528	34%	311	3.6	273	3.2
	Ratoath	3,794	7,249	91%	141	1.9	118	1.6
	Dunboyne	5,363	5,713	7%	248	4.3	188	3.3
	Trim	5,894	6,870	17%	355	5.2	238	3.5

	Kells	4,421	5,248	19%	303	5.8	249	4.7
	Dunshaughlin	3,063	3,384	10%	188	5.6	164	4.8
	Duleek	2,173	3,236	49%	118	3.6	106	3.3
	Stamullen	779	2,487	219%	85	3.4	45	1.8
	Athboy	1,538	2,213	44%	176	8.0	129	5.8
	Enfield	1,072	2,161	102%	15	0.7	7	0.3
	Oldcastle	937	1,316	40%	96	7.3	70	5.3
	Ballyvor	793	1,212	53%	70	5.8	50	4.1
	Slane	823	1,099	34%	40	3.6	30	2.7
	Clonee	173	1,000	478%	24	2.4	24	2.4
	Total Co. Meath	**62,199**	**85,545**	**38%**	**3,489**	**4.1**	**2,533**	**3.0**
Cavan	Cavan	6,069	7,663	26%	776	10.1	449	5.9
	Bailieborough	1,660	1,966	18%	185	9.4	115	5.8
	Kingscourt	1,307	1,748	34%	69	3.9	52	3.0
	Virginia	1,093	1,734	59%	181	10.4	113	6.5
	Ballyjamesduff	871	1,690	94%	107	6.3	84	5.0
	Belturbet	1,295	1,395	8%	105	7.5	72	5.2
	Cootehill	1,399	1,243	-11%	118	9.5	90	7.2
	Total Co. Cavan	**13,694**	**17,439**	**27%**	**1,541**	**8.8**	**975**	**5.6**
Monaghan	Monaghan	5,936	6,710	13%	804	12.0	476	7.1
	Carrickmacross	1,964	1,973	0%	284	14.4	206	10.4
	Castleblaney	1,712	1,822	6%	340	18.7	218	12.0
	Clones	1,721	1,517	-12%	50	3.3	42	2.8
	Total Co. Monaghan	**11,333**	**12,022**	**6%**	**1,478**	**12.3**	**942**	**7.8**
	Total Region	**153,580**	**186,537**	**21%**	**11,433**	**6.1**	**8,194**	**4.4**

Notes: *[1] Laytown/Bettystown is dispersed over two distinct areas and is was not possible to identify the town boundary area, for this reason the town is not classified as a main settlement.*
See table 2.6 for rural population

2.4.3 Spatial Distribution of Incidents (AS3)

AS3 ambulance activity concerns Patient Transport Services (PTS) and is considered to be non-urgent, routine patient services that use ambulance resources, mini-bus and local taxi services. Choice of service is based on patient needs and availability of resources. Control Room staff makes decisions on appropriate allocation of resources using locally adopted Standard Operating Procedures. Under these circumstances there exists considerable variability in the 'pick-up' location of patients and where they are taken to. The 'pick-up' location may be a patient's home, a nursing home, or a hospital. 'Pick-up' locations often cluster around hospitals where onward transport to another hospital in the region occurs (common from Monaghan Hospital) or from a major Hospital onward to specialist centres in Dublin, or Belfast. The North-Eastern Region 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. Where a patient is only being transported from the 'pick-up' location to the final destination the 'hospital attended' record is left blank.

The spatial distribution of 'pick-up' points in respect to the study spatial typology reflects the operational and secondary care environment in the North-Eastern region. Thus Our Lady of Lourdes Hospital in Drogheda as the principal hospital for the region attracts a considerable proportion of inward and outward AS3 activity (see table 2.11). Equally Monaghan and Cavan hospitals have a relatively high proportion of outward AS3 activity as patents are transported from it to either Drogheda or hospitals outside the region for treatments. Although these factors

skew the relationship between resident population and rates of AS3 activity there remains a good indication that high rates of AS3 activity concerns patients resident within urban areas.

Table 2.11 *Spatial Typology and AS3 incident rates in North-Eastern region*

Name	No. Incidents (AS3)	AS3 Incidents per 100 persons
Louth		
Towns & Villages	3,860	5.4
Rural Areas	47	0.1
Total	3,907	3.5
Meath		
Towns & Villages	1,010	1.2
Rural Areas	47	0.1
Total	1,057	0.6
Cavan		
Towns & Villages	1,214	7.0
Rural Areas	113	0.3
Total	1,327	2.3
Monaghan		
Towns & Villages	580	4.8
Rural Areas	61	0.1
Total	641	1.1
NE Region		
Towns & Villages	6,664	3.6
Rural Areas	268	0.1
Low Density Rural Area	0	0
Total	**6,932**	**1.8**

Table 2.12 provides a matrix of 'pick-up' locations by town against the hospitals where patients were taken. This indicates the highest patient movement occurred from Drogheda, with the majority of movement from there to the Louth County Hospital in Dundalk. Conversely the highest number of individual trips occurred between Dundalk and Our Lady of Loudres in Drogheda with 1,053 trips over the study period. The Royal Victoria, The Mater Private and Beaumont were the principal out-of-region hospitals attended. Relatively high numbers of trips from Cavan to the Royal Victoria were recorded. In respect to trips from Drogheda to Dublin the Mater Private was the most frequent hospital where patients were taken.

Of the total number of AS3 incidents (6,932) 4,107 were movements where the pick-up and hospital attended were within the region and 1,618 were to hospitals in Dublin or Northern Ireland, with a small number of movement to Mullingar. In total there were 719 AS3 incidents that took patients to Dublin.

Table 2.12 *Pick-up Location and Hospital Attended AS3 incidents*

Hospital Attended (To)	Pick-up Location by Town (From)					
	Cavan	Drogheda	Dundalk	Monaghan	Navan	Total
Our Lady Of Lourdes Drogheda	345	20	1,053	40	539	1,997
Louth County Hosp		904	74	3	7	988
Our Lady's Navan	3	343	6		4	356
Cavan General	18	150		179	7	354
Royal Victoria	113	48	89	51	52	353
Mater Public Hospital	22	130	66	6	21	245
Beaumont	37	56	43	11	35	182
Monaghan General	134	10		18	1	163
St James Hospital	11	23	32	5	5	76
Our Lady's Hospital, Crumlin	16	35				51
Connoly Memorial Dublin	5	7	15		23	50
Temple St Children's Hospital	12	32				44
Tallaght Hosp	13	5	6		11	35
St Luke's Dublin		10	9	1	5	25
Mater Private Hospital	1	3	10	2	2	18
St Vincent's Public	2	2	4	1	2	11
Holles St Dublin	3	3				6
Coombe Hospital	1	2			2	5
Rehab Dun Laoire			3	1	1	5
Rotunda Hospital - Dublin		1			1	2
Blackrock Clinic				1		1
Clogher Valley NH				1		1
Daisy Hill Hospital Newry	1					1
Eye & Ear Hospital Dublin				1		1
Glen Carn, Crossmaglen		1				1
Mullingar General Hospital	1					1
St Michaels Dun Laoire			1			1
St Vincent's Private			1			1
Other Hosp	*11*	*2*	*8*	*8*	*8*	*37*
Not Listed	*438*	*250*	*396*	*193*	*236*	*1,513*
Total	**1,187**	**2,037**	**1,816**	**522**	**962**	**6,524**

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

- That patient transport services are dominated by transport from hospitals in the principal settlements of Cavan, Monaghan, Navan, Dundalk and Drogheda.
- Cavan Town has the highest number of incidents relative to resident population and the third highest total volume of AS3 incidents in the region.
- Around 18% of the AS3 activity based from Cavan and Monaghan town is concerned with transfers from the hospitals in those towns.
- High levels of AS3 activity occurs between Cavan and the Royal Victoria compared to other towns.
- Trips for patients attending Dublin hospitals represent around 10% of the total volume of AS3 activity.

3. Performance Analysis

3.1 Performance Standards

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

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

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

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

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

Urban areas are defined as areas where population is greater than 100 persons per Km^2 (2.5 persons per acre 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. While in the case of the North-Eastern region with 20% of the area having a population density of less 20 persons per Km^2 and 25% of the total population resident in those areas the comparison with the UK may be reasonable. However it is important to bear in mind the significant difference that will occur on the western and southern coastal areas of Ireland which render direct adoption of the UK

standards problematical. Furthermore the distinction between Category 'A' and Category 'B' calls are not equivalent to the distinction between 'AS1' and 'AS2' incidents in the Irish context. Direct comparison of the results of the performance analysis presented here with other jurisdictions is therefore not yet fully feasible.

In section 2.4 we put forward a spatial typology based on census definitions of towns, and population density from the 2002 census. This typology usefully captures the fundamental settlement patterns of the Ireland 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 North-Eastern region

The average (median) response time for the study period for the entire North-Eastern region was 14.7 minutes for all AS1 & AS2 incidents within the region. For AS1 the median response time for all incidents was 11.5 minutes and 32.9 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 33% of all AS1 incidents are responded to in under eight minutes. In the main settlements 54% of all AS1 incidents are responded within eight minutes whereas in rural locations 19.4% of AS1 calls were responded to in eight minutes.

Table 3.1 % of Response Times within time bands by Spatial Type (AS1)

Spatial Type	% of AS1 Incidents Responded by					
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	>25 Mins.	% of all Incidents
Main Towns	54%	26%	11%	5%	4%	44%
Small Towns	11%	20%	25%	22%	21%	18%
Rural Area	19%	31%	20%	16%	14%	37%
Sparse Rural Area	0%	0%	0%	29%	71%	0%
Region Total	**33%**	**27%**	**17%**	**12%**	**11%**	**100%**

Table 3.2 % of Response Times within time bands by Spatial Type (AS2)

Spatial Type	% of AS2 Incidents Responded by					
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	>25 Mins.	% of all Incidents
Main Towns	15%	15%	9%	9%	52%	43%
Small Towns	2%	5%	4%	11%	77%	17%
Rural Area	2%	5%	6%	11%	74%	40%
Sparse Rural Area	0%	0%	0%	0%	100%	0%
Region Total	**8%**	**10%**	**7%**	**10%**	**65%**	**100%**

AS2 response times are substantially higher, 65% of AS2 calls are responded to in over 25 minutes compared to 11% of AS1.

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 may be overstated for the region. In the study of the National Ambulance Service Midlands region MPDS codes were queried to assess the potential impact of isolating 'life threatening' calls. It was demonstrated that a higher percentage of 'life threatening' calls were responded to within eight minutes than for the total AS1 incidents.

Across the region there is significant variation in responsiveness according to settlement patterns and incident demand criteria as described earlier (see table 3.3). There is a higher percentage of incidents responded to the towns and villages in Louth compared to other counties, where more concentrated urban settlement provides the opportunity to provide lower response times. This feature of service distribution strengthens the case for reconfiguration of the ambulance service toward one that is more closely located to potential demand. This is discussed in the following section of the report.

Table 3.3 Response rates by county and settlement type

Location	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	>25 Mins.	
Louth						
Towns & Villages	58%	29%	7%	4%	2%	28%
Rural Areas	24%	36%	19%	12%	10%	10%
Total	49%	31%	10%	6%	4%	38%
Meath						
Towns & Villages	26%	22%	28%	13%	11%	20%
Rural Areas	22%	340%	199%	150%	15%	17%
Total	24%	264%	235%	134%	34%	36%
Cavan						
Towns & Villages	29%	106%	55%	77%	14%	7%
Rural Areas	15%	73%	49%	65%	19%	7%
Total	22%	87%	52%	70%	33%	14%
Monaghan						
Towns & Villages	34%	83%	88%	129%	11%	7%
Rural Areas	6%	115%	181%	148%	6%	4%
Total	25%	95%	121%	136%	17%	11%

Within the ten main settlements the variability of AS1 percentage response rates shows direct correlation to the presence or otherwise of an ambulance station. Cavan, Drogheda, Dundalk, Monaghan and Navan all achieve response time greater than eight minutes close to, or well above 50% of the time. In Drogheda and Navan an eight minute response time was achieved for 68% and 75% of the AS1 calls from within those settlements. In contrast other settlements without the presence of an ambulance station rarely achieve an eight minute response time, with the best performing settlement being Kells at 8% of AS1 calls being responded to by eight minutes. The towns of south Meath that have enjoyed the highest population growth present some of the worst performance in terms of response rates, with for example just 2% of calls from Ashbourne being responded in eight minutes.

Table 3.4 Response rates by county main settlements

Spatial Type	% of AS1 Incidents Responded by					% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	>25 Mins.	
Ashbourne	2%	8%	43%	29%	19%	4%
Cavan	49%	33%	7%	4%	7%	7%
Drogheda	68%	22%	6%	3%	2%	23%
Dunboyne	5%	32%	28%	15%	20%	3%
Dundalk	54%	35%	6%	3%	2%	34%
Kells	8%	26%	44%	14%	8%	4%
Monaghan	64%	21%	5%	5%	4%	8%
Navan	77%	16%	4%	1%	2%	10%
Trim	4%	15%	55%	19%	7%	4%
Ratoath	5%	43%	23%	15%	14%	2%

In section 4 of this study operational tactics are presented which aim to 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 North-Eastern region to the ambulance service is one of the key deliverables of the project. The fundamental configuration patterns recommended within the TDP of the North-Eastern region is contained within this package 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 assumption within the plan, and distribution of recommended 'response origins'. Readers are pointed to the package itself to gain a complete view of the TDP for the North-Eastern 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 edited dataset, hotspot maps of demand have been created. AS1, AS2 and AS3 are separately analysed and counted firstly into 3km grid squares, from where the 500m concentration of demand within each "hot" 3km grid square can be found. Once the 500m hotspots are identified, a suitable point on the road network on which to stand by can be selected within the immediate vicinity, usually a fast road or crossroads to maximise response potential. This methodology identifies **Response Origins** across the operational region.

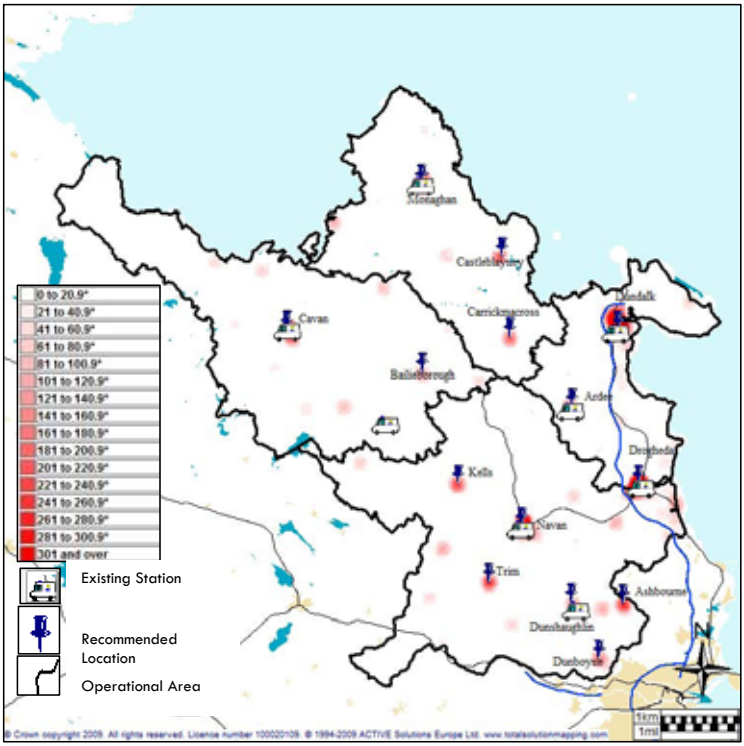


Figure 4.1 *Shows the locations of existing stations and recommended demand based response origins. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.2 Response Footprint Formation

Response Footprints are geographic areas that describe a part of the operational 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 correspondence to actual operational conditions. 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.

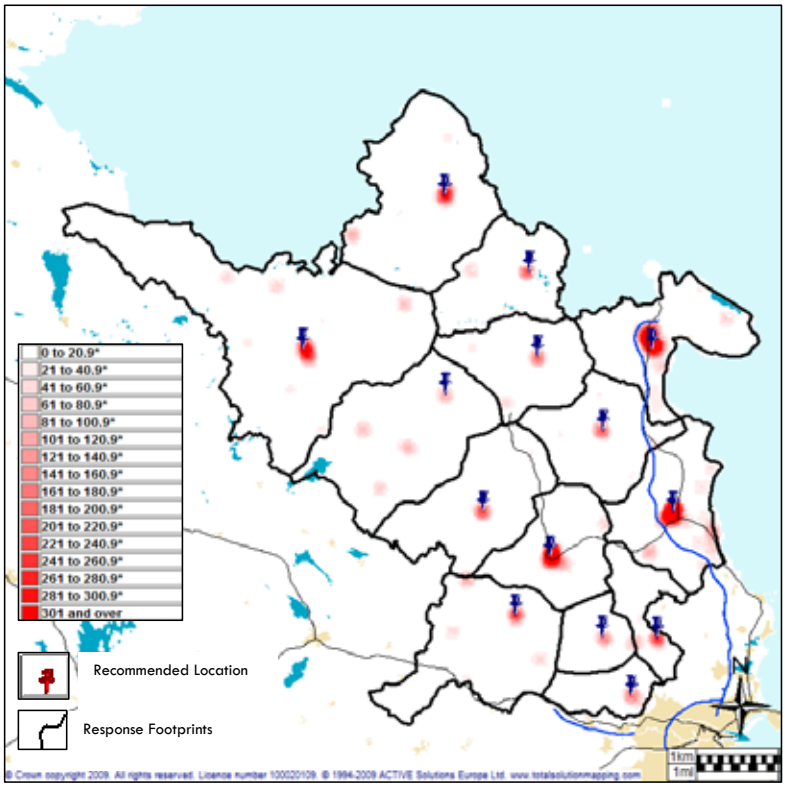


Figure 4.2 *Shows the locations of the recommended demand based response origins and response footprints around each. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.3 Tactical Deployment Plan

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

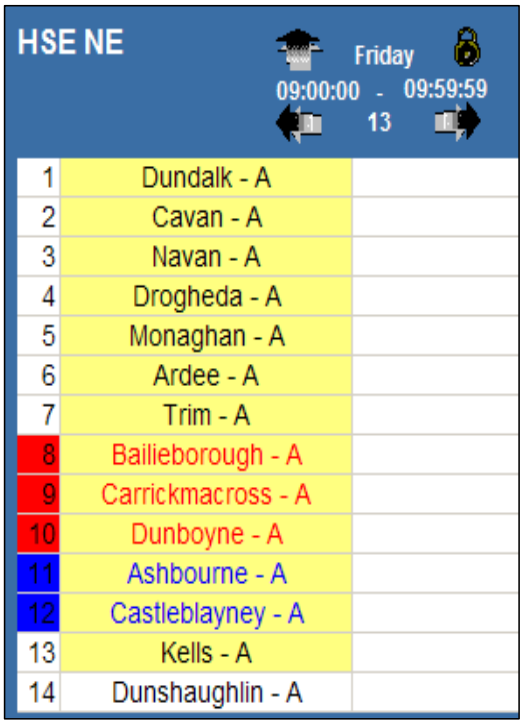


Fig. 4.3 *Example of TDP viewer output*

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.

Within the TDP viewer the priorities for each station for each hour of each day is 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.

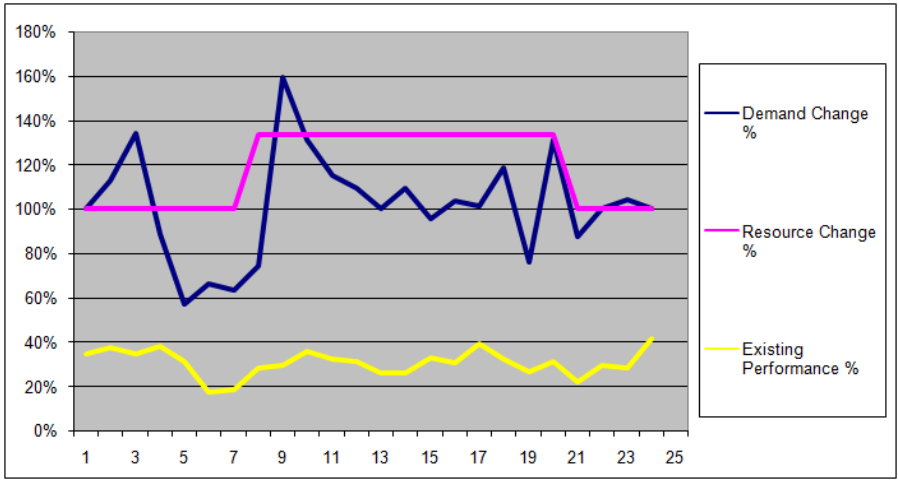
The table below shows the current number of scheduled vehicles available for all workload, set out by hour for an average working week. This is derived from resource figures and crewing arrangement provided by the North-Eastern Region Ambulance Service. The PTS crews are excluded as the TDP focuses on AS1 performance.

Table 4.1 *Schedule of resources*

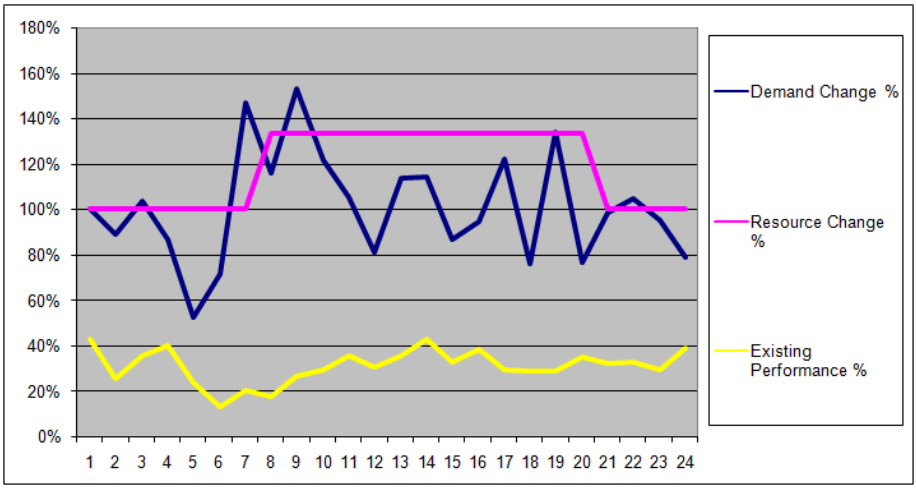
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun	10	10	10	10	10	10	10	13	13	13	13	13	13	13	13	13	13	13	13	13	10	10	10	10
Mon	10	10	10	10	10	10	10	13	13	13	13	13	13	13	13	13	13	13	13	13	10	10	10	10
Tue	10	10	10	10	10	10	10	13	13	13	13	13	13	13	13	13	13	13	13	13	10	10	10	10
Wed	10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

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 for the edited dataset. 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.

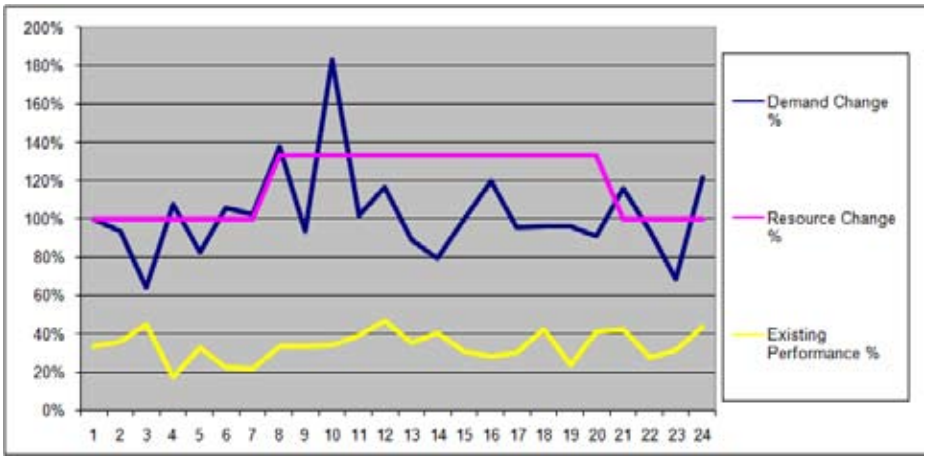
Sunday



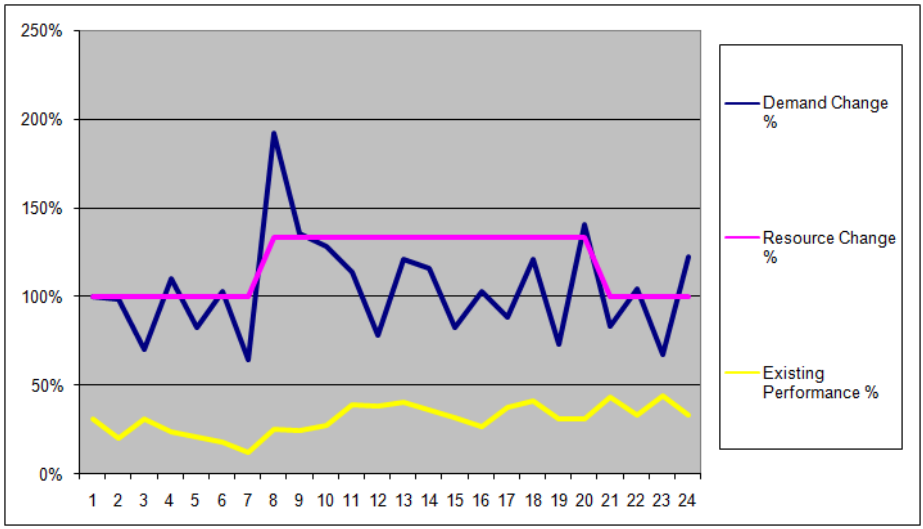
Monday



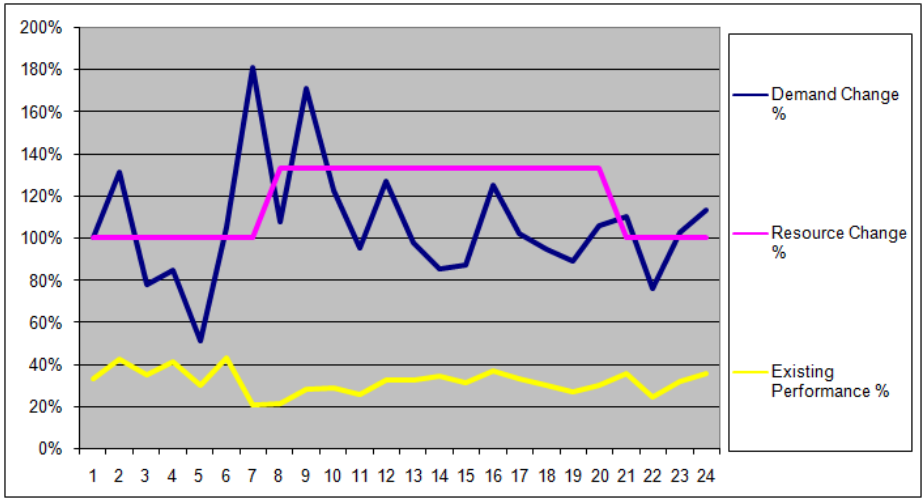
Tuesday



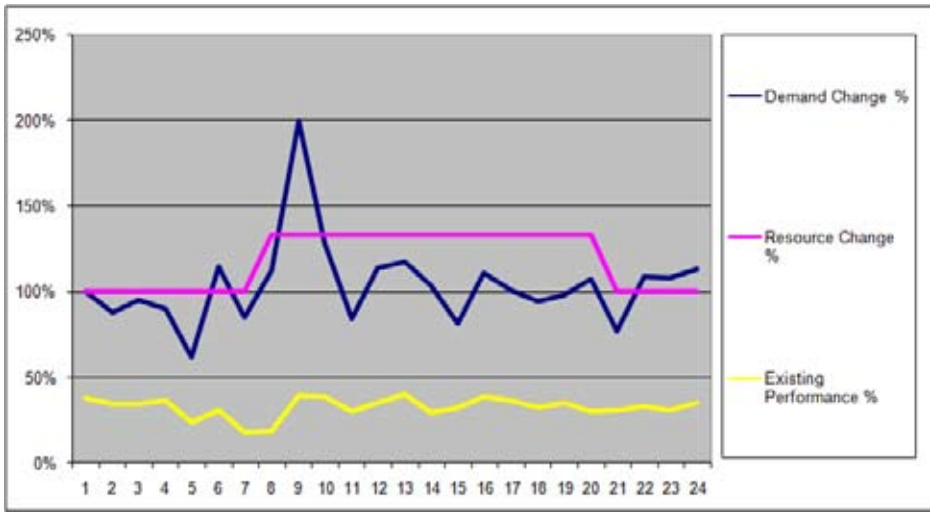
Wednesday



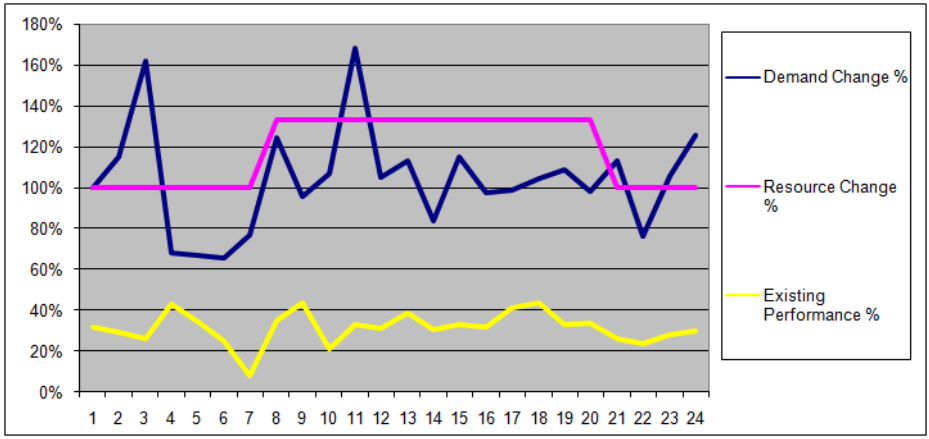
Thursday



Friday



Saturday



4.4 Impact of PTS Workload

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

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

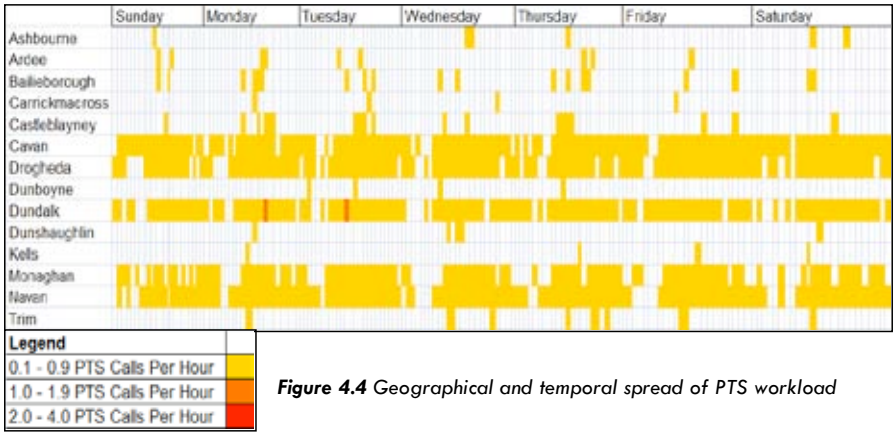


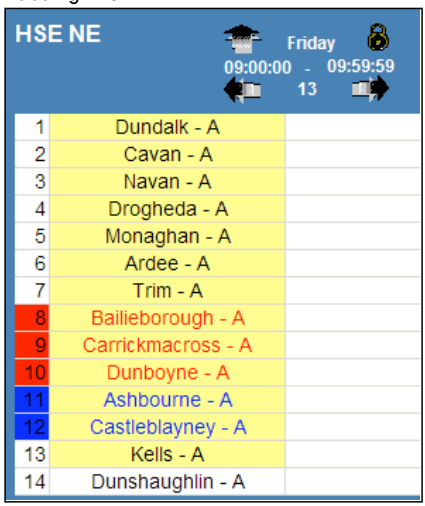
Figure 4.4 *Geographical and temporal spread of PTS workload*

This shows that Dundalk have high PTS demand throughout the week. In some hours up to two PTS calls are being carried out, which means two less ambulances available to emergency work, probably for several hours after the time the PTS task commenced. 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 Dundalk and Drogheda although using the edited dataset the number one station should be Dundalk, because the demand is higher than anywhere else.

Figure 4.5 is for Friday morning 09:00am – 09:59am. This shows that if the PTS demand is included, Dundalk would get the first vehicle available. The picture is very different if PTS data is excluded and the plan is based on emergency and urgent incidents only.

Including PTS



Excluding PTS

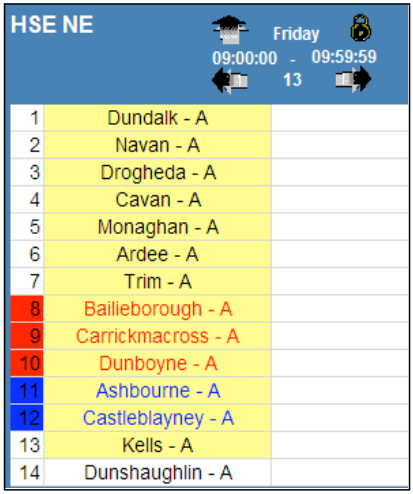


FIG 4.5 *Impact of PTS Workload on the TDP using the edited dataset*

Figure 4.5 also shows that the reduction in the overall demand means that the same number of resources are required when including or excluding PTS incidents. Other than the top four response origins the remaining response origins remain in the same order when including or excluding PTS incidents.

4.5 Tactical Deployment Plan Impact Analysis

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

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

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

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

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

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

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

4.5.1 Performance Forecasts

In the absence of any guidance as to current or future performance standards for the North-Eastern Regional 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.

AS1 incidents are assumed to be life threatening Category 'A' incidents. 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.

Figure 4.6 below shows the current and the forecast performance for the different scenarios as previously described, against a response standard of eight minutes for all Category 'A' incidents. The dataset used has excluded those AS3 incidents that were serviced by PTS vehicles. The current performance indicates 32.7% calls are responded to within eight minutes.

As less vehicles are used to manage AS3 incidents there is a significant increase in performance under scenario 1 and through the TDP the available resources are better distributed in relation to

AS1 demand. The increase between scenario 1 and 2 is not as large as a substantial amount of AS3 is already being serviced by intermediary care vehicles. Scenario 3 suggests an increase in performance to 68%, indicating that resource availability is an important determinant in performance.

Performance Dashboard

Daily Overall Performance		Current Performance	Scenario 1 Performance	Scenario 2 Performance	Scenario 3 Performance
	Sunday	31.8%	50.4%	53.5%	67.5%
	Monday	32.5%	54.1%	56.2%	67.2%
	Tuesday	34.6%	54.8%	57.5%	68.6%
	Wednesday	32.6%	54.4%	57.9%	68.3%
	Thursday	31.8%	57.0%	59.8%	69.8%
	Friday	33.7%	54.9%	58.2%	68.7%
	Saturday	31.8%	52.5%	55.3%	68.7%
Monthly Overall Performance		32.7%	54.0%	56.9%	68.4%

Figure 4.6 *Performance Dashboard for the (excludes AS3 undertaken by PTS vehicles)*

Summary

- Implementing the TDP should improve responsiveness to emergency demand by around 21 percentage points. This is based on the continuing use of PTS vehicles for a substantial amount of the PTS (AS3) demand by intermediate care vehicles.
- As there is already a substantial amount of PTS work load being serviced by intermediate care vehicles there is only a relatively small increase in performance in all PTS activity handled by the intermediary care fleet.
- Improving efficiency in use of resources (reducing abstraction rates) together with exclusion of PTS activity increases performance by around 14 percentage points from scenario 1.

4.5.2 Impact of Additional Vehicles

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

If resources are unlimited, then the best performance is 68.4% 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

Adding one vehicle to scenario 1 would give the greatest impact because this scenario assumes the lowest number of vehicles available. In this scenario the vehicle could be either an ambulance or an intermediate care vehicle which would free up an emergency ambulance for emergency work.

The impact of additional vehicles in scenarios 2 and 3 becomes less 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%	2.7-3.0%	2.3-2.6%	1.2-1.5%

5. Demographic trends and service hierarchy implications.

This section sets out the future population projections and infrastructural provision for the National Ambulance Service North-Eastern Region comprising the counties Meath, Cavan, Monaghan and Louth. This analysis will be considered within the context of the National Spatial Strategy, the National Development Plan 2007-2013, the relevant Regional Planning Guidelines (RPGs) and the relevant County Development Plans. The relevant RPGs are the Border Regional Planning Guidelines (of which Cavan, Louth and Monaghan are part) and the Regional Planning Guidelines for the Greater Dublin Area (containing Meath county). Current considerations in respect to future regional hospital provision is assessed.

5.1 Demographic and Regional Trends

5.1.1 Context

The North-Eastern region spans across two important planning regions consisting of a large proportion of the Border region plus a portion of the Mid-Eastern region. The Border region of Ireland has long been associated with peripherality and disadvantage. It is distanced from the main urban centres of Ireland and infrastructure provision has come late to the region. The bulk of the region lacks any natural geographic or economic cohesion. The region faces difficult political, socio-economic and physical barriers to development. The close proximity to Northern Ireland has meant that many decisions must be made within the confines of sensitive political beliefs and moral codes. Also the only strong urban centres that have evolved are located close to the border of Northern Ireland, effectively distorting the progression of the region. Indeed the area faces a number of challenges and is addressing them via the National Spatial Strategy and the Regional Planning Guidelines for the Border region.

In direct contrast, the Mid-Eastern region of Ireland faces constant development pressures and sustained population growth. The Greater Dublin Area currently makes up 39.2% of the population of the State and the total projected population for 2021 is 5 million (CSO Regional Population Projections). The greatest challenge for this region is the persistent imbalances in the distribution of the population and the increasing commuting to the metropolitan area due to greater housing provision and affordability in the hinterland.

5.1.2 Population Projections

In 2006, the population of the North-Eastern region was 394,098 persons. This represented an increase of 46,098 persons from the 2002 figure (348,000). The greatest percentage increase during the 2002 to 2006 period was in County Meath, where a population increase of 21.5% was recorded. This reflects the close proximity of County Meath to Dublin and the ever increasing commuter belt around the capital city. Monaghan recorded the slightest percentage population increase over the period, standing at 6.5%. This was below the national average of 8%. Louth and Meath have the greatest percentage of population in aggregate town areas, standing at 64.4% and 52.6% respectively. Only 26.4% of Cavan's population live in aggregate town areas, while Monaghan has 28.6% of its total population residing in aggregate town areas. The State average is 60.7% (CSO 2006). These figures have major impacts of the effective provision of infrastructure and health services.

The CSO Regional Population Projections (published 2005) have provided that the number of old persons (65 years and over) will increase in every region over the life-time of the projections (up to 2021), with the most marked increases likely to occur in the Mid-Eastern region and in Dublin.

An increase of 133% is projected for the Mid-Eastern region. Ageing population (those aged 80 years and over) is projected to increase by two-thirds by 2021, with an increase of about 90% projected for the Mid-Eastern region, of which County Meath is part. This provides further challenges for public service provision, especially the provision of efficient health services including ambulance services.

Population projections for the North-Eastern region and the various counties are displayed in the below tables. While it is difficult to be definitive due to the different scales and sources used it we consider that projections by the HSE are too conservative and do not properly reflect future forward planning policy and continuing demand for residential development, particularly in Meath and Louth. Overall it would appear that a total population approaching 500,000 persons by 2020 with Meath and Louth absorbing the majority of the growth.

Table 5.1 *Regional Projections from CSO (2005) & the Regional Planning Guidelines planning regions*

Region.	CSO Population Projection. (1000's)		Regional Planning Guidelines 2020 Population Projection.
	2021 CSO MIF2 (Recent)	2021 CSO M1F2 (Medium)	
Border Region.	566	546	280 (Eastern) [1]
Mid East Region.	639	623	High = 2,302 Low 2,303

Note: [1] represents Monaghan, Cavan and Louth.

Table 5.2 *Localised Projections from County Development Plans and the Regional Planning Guidelines*

County	Regional Planning Guidelines 2020	County Development Plan.
Cavan	(2020) Cavan Town; 16,000.	-
Monaghan	(2020) Monaghan Town; 15,000.	17,878 (year=2021)
Louth	(2020) Dundalk Town; 60,000.	172,000 (year = 2020)
Meath	-	210,000 (year = 2013)

Table 5.3 *County projections produced by the HSE in 2005*

County	Projection Year (000's)		
	2006	2010	2020
Cavan	59.7	62.9	71.0
Louth	107.6	113.2	126.4
Meath	149.0	163.9	199.7
Monaghan	55.6	58.4	65.6
Total	**372.0**	**398.5**	**462.6**

Source: Population Growth by County, Health Services Executive Report Figure 8

5.2 Policy Documents

5.2.1 National Spatial Strategy

The National Spatial Strategy (NSS) is a twenty year planning framework with a core aim of achieving balanced social, economic and physical development of regions. It provides that through the closer matching of where people live and where they work, a better quality of life can be achieved together with a more economically competitive position and higher environmental qualities. The NSS recognises that much of Ireland's recent prosperity has been focused in the Greater Dublin Area. This affects the North-Eastern region through encouraging commuting from the region and from Meath especially, and by distorting the progression of the rest of the region in comparison. This process leads to an imbalance of population and hence an imbalance of services available. This leads to externalities; monetary, social and environmental. The NSS divides theBorder region into three component parts;

- -the North-Western part, namely Donegal,
- -the Western part, namely Sligo and Leitrim,
- -the Central and Eastern part; Cavan, Monaghan and Louth.

It is this final area consisting of Cavan, Monaghan and Louth that is of concern here. Through the designation of Dundalk as a gateway and Cavan and Monaghan as hubs, the NSS hopes to achieve critical mass and increase the regions capacity for growth. It is expected that Monaghan will build on its strategic location between Derry and Dublin on the N2 and its links with Armagh. Cavan occupies a strategic location on the N3 leading on to Enniskillen and the town itself serves an extensive hinterland. Dundalk town's population grew by 5.9% to 29, 010 in the period from 2002 to 2006 (NDP 2007-2013; pg.72). Dundalk is strategically located mid-way along the Dublin to Belfast corridor and its attributes include broadband, the M1 Motorway, airport and port access, the Dundalk Institute of Technology and it is in close proximity to Newry City in Northern Ireland. The National Development Plan 2007-2013 identified the main challenges for Dundalk to be strengthening and broadening its economic and enterprise structure, continuing to tackle social exclusion and the need for increased supply of housing to the west of the town. The NSS is proposing that these hub and gateway designations will form reference points for the region and will lead to the advancement of the region as a whole. Through reaching critical mass, the regions dependency on the Greater Dublin Area can be lowered, hence reducing the divide that exists between the south-east of the region (Meath) and the remaining area.

Navan has been identified as a 'Primary Development Centre'. A Primary Development Centre is a strategically placed, strong and dynamic urban centre that has the capacity to redirect development within the hinterland of the Greater Dublin Area. The issues that arise in relation to these centres are how they can energise their own catchments and their relationships with areas in neighbouring regions. A population of approximately 40,000 is necessary for each centre to be self-sustaining. However, it is also necessary that the primary centres do not undermine the ability of other areas to reach critical mass. This represents the greatest challenge for Navan town in the coming decades.

5.2.2 National Development Plan 2007-2013

The National Development Plan 2007-2013 proposes to ensure balanced regional development through an ambitious investment programme based around the spatial policies of the NSS. The programme for investment in infrastructure deficits should benefit the North-Eastern region through the designation of the Border region as a NUTS II Region.

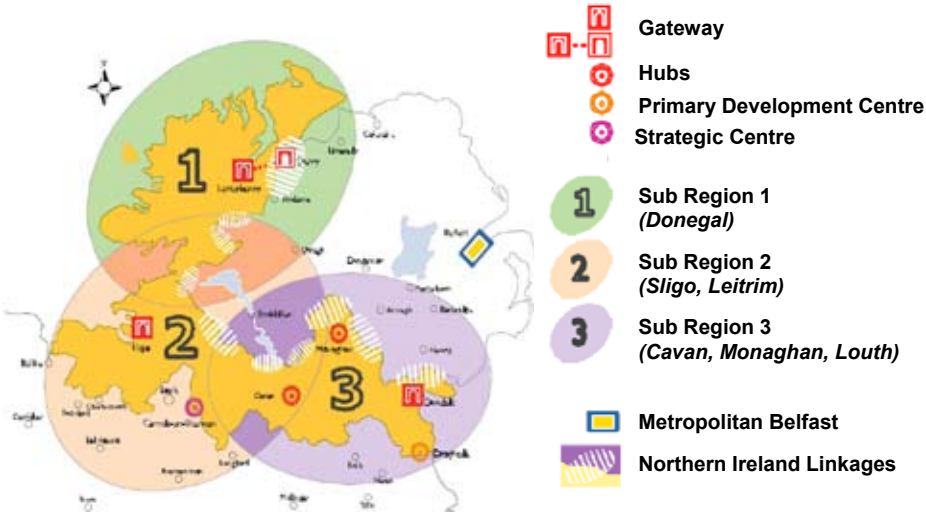
The NDP states that the growth of the Greater Dublin Area (GDA), comprising the four Dublin Councils and counties Kildare, Meath and Wicklow, has been dramatic in terms of population and economic output. The plan refers to the infrastructural demands that have arose as a result of the

growth of the GDA, namely in transport, housing and environmental services. The plan goes on to state that the development of the country outside the GDA must be pursued intensively. This is necessary to ensure a more balanced population distribution and a more even spread of economic benefits.

5.2.3 The Regional Planning Guidelines for the Border Region

The Border region consists of Donegal, Sligo, Leitrim, Cavan, Monaghan and Louth. These guidelines recognise that as a precondition to development, effective infrastructure is required. A key issue for the Border region is the overall connectivity and infrastructural deficit. There is an urgent need for infrastructure provision to ensure that any development embarked upon is sustainable in the long term. At present the RPGs state that Cavan, Monaghan and Louth are commuting towns for Dublin and its hinterland due to the geographical boundaries of the three counties with Dublin and the Mid-Eastern region. Both regions are well connected by road and rail to Dublin and Belfast. The Dublin to Belfast corridor encourages growth along its catchment area and has led to the growth of Drogheda town; however it does so at a cost to the remainder of the region.

Figure 5.1 *Sub-Regional divisions and general settlement strategy for the Border region (Regional Planning Guidelines, Border Regional Assembly, May 2004)*



Source: Border Regional Planning Guidelines, 2004.

5.2.4 Local Authorities

Meath County Council have recognised that the current transportation trends of the county are unsustainable owing to the high dependence of the private car and the significant proportion of the population commuting to Dublin on a daily basis. County Meath is very dependent on its road infrastructure for inter and intra county transportation. Accordingly, a number of current road projects are underway in relation to improving the regional road network in the county; R161 Navan - Trim route, R158 Trim - Summerhill - Kilcock and the R150 Duleek - Julianstown. The Meath County Development Plan states that the first phase of each project has been completed.

Louth County Council also emphasise the improvements in infrastructure that are being embarked upon in order to make Louth a more economically and socially attractive destination. The county is intersected by the EO1 Euro Route/M1 Motorway, the national primary route from Dublin - Derry (N2) and the Dublin – Belfast rail line. The secondary routes N51 Drogheda - Navan, N52 Dundalk - Kells and the N53 Dundalk - Castleblayney provide important links to the remainder of the county. Louth County Council have objectives to provide and maintain a road hierarchy based on motorway, national routes, regional routes and all county roads and to prohibit any development that would result in the creation of traffic hazard or traffic congestion. This ensures that the sustainable development of the county is ensured by prohibiting any development that would deteriorate its existing and/or future road infrastructure.

Cavan County Council state in the development plan that the main population characterises of the county are;

- a dispersed rural population with small urban centres,
- an unbalanced population structure with a large proportion in the older age groups, a correspondingly smaller proportion in the reproductive age groups and large numbers of single males in rural areas,
- a population with low birth rates, high death rates and high out-migration.

These trends present formidable challenges in the provision of public service goods, both physical and social infrastructure. Correspondingly, the settlement pattern of the county also raises a number of challenges and is in line with the overall challenges of the region. A survey carried out by Cavan Local Authority revealed a settlement pattern comprised;

- predominantly individual rural dwellings,
- a well distributed pattern of towns and villages throughout the county but with low population levels,
- a weak urban hierarchy of main towns dominated by Cavan town,
- a continuing demand for urban generated housing around the main towns,
- a sparsely populated western area.

These trends pose considerable challenges to the provision of health care services. Locational decisions concerning service are far more difficult given the dispersed nature of population and the high and increasing category of dependent persons.

Cavan County Council have prioritised the following communication corridors; the N3 (Dublin – Cavan – Donegal), the N54/N55 (Athlone – Cavan – Belfast), the N16 (Sligo – Enniskillen) and the anticipated east – west link and the national road network is planned to be continually upgraded. This includes the bypass proposals affecting the N3 (Virginia – Cavan – Belturbet) and the N55 (Ballinagh – Longford County Boundary).

Monaghan County is traversed by three national routes; the N2 Dublin – Derry National Primary Road, N12/N54 Belfast – Galway (Armagh – Monaghan – Clones - Cavan) and the N53 Dundalk – Sligo and the East – West (Castleblayney – Dundalk) route. The national road and motorway network provide the county's towns with efficient and timely access to Dublin and other principal towns, airports, seaports and Northern Ireland. However, there has been a significant increase in traffic in Monaghan county in the foregone decade with a threefold increase in the number of vehicles licensed in the county between 1993 and 2004. A number of negative impacts have been felt by many county towns including environmental degradation, traffic congestion as well as reduced pedestrian access, deteriorating business development opportunities and inadequate access to urban areas. The current Capital Road Works Programme which is to be completed over the lifetime of the development plan will address a number of these negative impacts.

5.2.5 National Roads Authority

The National Roads Authority (NRA) was formally established as an independent statutory body under the Roads Act 1993. The following road schemes are underway in the various counties of the North-Eastern region.

County Cavan

Scheme:	Stage:
N3 Virginia Bypass	Preliminary Design
N3 Virginia to Cavan	Feasibility Study
N3 Belturbet Bypass	Preliminary Design
N16 Glenfarne to Blacklion	Feasibility Study
N16 Manorhamilton to Glenfarne	Route Selection
N55 Cavan Bypass Link Road	Complete
N87 Ballyconnell Inner Relief Road	Preliminary Design
N87 Belturbet to Ballyconnell	Route Selection

County Monaghan

Scheme:	Stage:
N2 Monaghan to Emyvale	Preliminary Design
N2 Castleblayney Bypass	Complete
N2 Monaghan Town Bypass	Complete
N2 Clontibret to Monaghan	Feasibility Study
N2 Carrickmacross to Castleblayney	Feasibility Study
N2 Carrickmacross Bypass	Complete
N54/N2 Link Road (Monaghan Town)	Preliminary Design
N2 Carrickmacross to M1	Constraints Study
N53 Ballynacarry Bridge (Co. Monaghan)	Constraints Study

County Louth:

Scheme:	Stage:
M1 Dundalk Western Bypass	Complete
N1 N.I. Border Dundalk	Complete
N2 Ardee Bypass	Preliminary Design
N2 Collon Bypass	Constraints Study
N2 Carrickmacross to M1	Constraints Study

County Meath

Scheme:	Stage:
N2 Slane Bypass	Preliminary Design
N2 Ashbourne Bypass / M50 Junction	Complete
N2 Collon Bypass	Constraints Study
M3 Clonee/North of Kells	Construction
N51 Navan Inner Relief Road	Construction

Much funding for road infrastructure has been made available under the NDP 2007-2013 and its associated Transport 21 Programme, which includes the provision of funding for roads connecting designated gateways to Dublin.

5.2.6 Navan Regional Hospital

Navan town has been selected as the new location of the main regional hospital for the National Ambulance Service North-Eastern region. The criteria that led to this decision are contained in the HSE Report 'Improving Safety and Achieving Better Standards: An Action Plan for Health Services in the North-Eastern Region'. A minimum catchment population of 300,000 was identified for the new hospital. In analysing the demographic breakdown on a county-by-county basis in order to identify which county had both the population to support the hospital from a staffing point of view and also which county had the most service requirement for the hospital, it became clear that Navan was the optimum location. In addition the following aspects were also considered;

Geographic Location
The location needs to be sufficiently to the south within the North-Eastern region to attract patients who would otherwise use North Dublin regional hospitals, while also ensuring that most of the residents in the north of the Eastern region would also use this same regional hospital.

Planning and Development Considerations
The location must have the capacity to accommodate the regional hospital from a planning and development point of view.

Relationship with existing hospital services
The interdependency of the location in the southern parts of the North-Eastern region with the locations and catchments of current hospitals and future regional hospitals in North Dublin requires consideration.

Concerns regarding the infrastructural capacity of Navan and the ability of local roads to accommodate the additional traffic and indeed the ambulance services were raised. The report '*Location for New Regional Hospital in the North East*' indicated that Navan benefits hugely from its position between the M3 and N2, which link the north to the south of the region and allows for access for residents in Monaghan, Cavan and Louth. The report went on to state that Navan also benefits from good quality roads linking the east and west of the region in the form of the N51 and the N52. Also it is likely that the proposed outer orbital route currently being considered by the Department of Transport will be a benefit to Navan and its hinterland. These improvements are enhancing Navan's capacity to accommodate the new hospital, and potentially contribute to health service provision in the North East.

5.3 Implications for Ambulance Services and Service Hierarchy

The fundamental implication for the ambulance services from demographic and development trends are clearly that demand for services will increase. Not only will there be between 25% to 30% more people to service by 2020 but their location in the region will have important implications for service demand. In section 2 we demonstrated that urban areas generated significantly more demand for both AS1 and AS2 services, given that most population increase will occur in urban areas, percentage increase in demand are likely to reflect the higher call rates associated with urban areas. Another aspect is the aging of population, rural areas will have significantly higher proportions of older people than at present, demand for services for older people will clearly increase.

Road improvements will improve accessibility between towns and villages connected by or close to national primary and secondary routes. Intra-regional accessibility remains an issue however as primary routes form distinct corridors, namely Dublin – Dundalk, Dublin – Navan, Dublin – Cavan, with poor connectivity between these corridors.

5.4 Summary

The North-Eastern region faces a number of challenges in the coming years and sustainable development is contingent on the implementation of the aforementioned plans, their infrastructural proposals and service provisions. The lack of urban centres in the North-Western parts of the North-Eastern region together with the ever increasing development pressures in the south of the region mean that the provision of services, especially health service services is challenged by the skewed nature of the regions layout and population trends. Between 2002 and 2006 County Meath showed the greatest population increase in the State at 21.5% increase. This is in contrast with County Monaghan whose own growth rate was below the national average and stood at a mere 6.5%. This highlights the contrasts that exist within the region and the challenges faced when choosing means of equitable health care provision.

The area is also noted for its need for road infrastructure improvement which will prove vital in the near future. The provision of road infrastructure is high on the agendas of the associated development plans but intra-regional connectivity will remain an issue for the ambulance services.

One of the greatest challenges is the dispersed nature of the population of the region. Cavan County Council has made specific reference to its ageing population, a trend that is increasing throughout the region according to CSO Regional Population Projections (2006-2021). Targeted 'First Responder' schemes are likely to be of benefit in these areas where population levels make it impossible to establish points of origin in the Tactical Deployment Plan.

Overall, the provision of equitable and sustainable health care services in the North-Eastern region will undoubtedly pose a number of challenges. The continuing improvements in the road infrastructure together with increasing communication technologies will be of benefit. The decision to locate the regional hospital in Navan has been based on selected criteria that are considered to be the best solution for the regions dispersed population.

6. Conclusions & Recommendations

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

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

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

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

R1) Transfer methods of analysis to other regions:

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

R2) Future Data Capture and Patient information:

A pressing issue arising from this study is the need to identify 'life threatening' incidents within the AS1 incident type. There are recognised operational difficulties in this requirement, and we are aware of work in this regard being undertaken by the Pre-Hospital Emergency Care Council. The findings in this study demonstrate the operational imperative of implementing MPDS into the ambulance services and that this should apply

ProQA (or equivalent) standards. This imperative also extends to information on patient needs for Patient Transport Services.

R3) TDP Implementation Support:

The TDP developed in this study has demonstrable significant potential benefits for enhanced responsiveness to emergency incidents in the North-Eastern region. The analysis demonstrated that without any additional crew or vehicle resources a 21.3% increase in achieving AS1 response times in less than eight minutes was likely. Management and staff support, together with appropriate training and consultation, is required to implement the TDP. In addition to a number of technical issues (principally concerning exact positioning 'response origins') there are significant changes in operational practice within the ambulance service that require management guidance. Ongoing support from all agencies concerned is required to ensure its successful implementation.

R4) Inter-regional methodology:

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

In addition to the broader recommendations above there are a number of specific recommendations and actions that are relevant to the North-Eastern Ambulance Service region, these are:

R5) Revision of TDP:

Given the rapid population growth, ongoing urban growth and changes in infrastructure, updated TDP exercises will be required for the north east within three to four years. Of particular concern are the high growth areas along the coast and those newly developed settlements toward Dublin City.

R6) Operational Implementation of TDP:

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

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

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

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

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

R8) Addressing future demands

The analysis has demonstrated that high demand arises in urban centres, 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 a requirement for the addition of response origins in Ashbourne, Dunboyne, Dunshaughlin, and Trim for the high population growth areas of south Meath. Currently the area is serviced only through the existing ambulance station at Dunshaughlin, as response times for this part of the region had the poorest level of performance; the provision of the response origins as indicated will significantly improve performance for the region as a whole.

The spatial distribution of demand suggests that a response origin is not required in Virginia, response origins at Cavan, Ballieborough and Kells are considered to adequately address emergency demand in this part of the region.

R9) Patient Transport Service & Inter-agency consultation:

Provision of PTS (AS3) in the National Ambulance Service North-Eastern region is now being substantially addressed through the use of intermediary care vehicles. This study comprehensively demonstrated the benefits of using intermediary care vehicles for PTS as there were significantly more resources available to focus only on emergency care demand (AS1) and performance increases potentially available through the use of tactical deployment methods are higher when all PTS is excluded. Further analysis 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 AS2 peak workload and thereby further contribute toward enhanced emergency care provision for AS1 calls.

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