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Demand Analysis and Tactical Deployment of Ambulance Services in the HSE North-West Area.

December 2006

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Pre-Hospital Emergency Care Council

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DEMAND ANALYSIS AND TACTICAL DEPLOYMENT OF AMBULANCE SERVICES IN THE HSE NORTH-WESTERN AREA

A report for the Pre-Hospital Emergency Care Council & the Ambulance Service HSE NW Area

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Pre-Hospital Emergency Care Council

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1. INTRODUCTION AND BACKGROUND

This project was initiated by the Chief Ambulance Officer of the HSE North West Area in December 2004, and was funded by the Pre-Hospital Emergency Care Council. The study is the first of its 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 area. 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 HSE NW Area based on results from demand and performance analysis; and secondly, to provide a research template for data issues and techniques that can be utilised throughout Ireland to assess Ambulance service performance and 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 HSE North West Area.
- **ii)** To explore spatial options required to produce a Tactical Deployment Plan (TDP) that will improve response times for emergency patients.
- **iii)** To communicate the optimum deployment plan and enable query by day or hour in relation to current configuration of services.
- **iv)** To examine the sensitivity of the TDP in respect of current trends – taking into account population trends, development planning and road changes.
- **v)** Consider on the implications of service hierarchy that will make optimum deployment of possible Advanced Paramedic services, standard EMT/Paramedic services and Community Responder/Co-Responders in the context of dynamic deployment within the Tactical Deployment Plan (TDP)

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 USA. A steering committee lead by Dr. Geoff King of the Pre-Hospital Emergency Care Council guided the contractors through the project. Other members of the steering committee were Frank McClintock, Assistant Director National Hospitals Office, HSE, Pauric Sheerin, Acting Chief Ambulance Officer HSE North West Area and Anthony Cummins, Communications Officer HSE North West Area.

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. Two meetings were held in Manorhamilton, which were open to all Ambulance staff. The initial meeting provided an overview of the project aims and results of some initial findings. The second meeting, attended by over 30 staff demonstrated how the Tactical Deployment Plan for the region was developed and presented completed findings.

Study Period and Data Collection

Data for the study was supplied by the Ambulance Service of HSE North West Area and covers the period 1st July 2004 to 30th June 2005. This period was considered appropriate to allow a suitable overview of demand for Ambulance services to generate the first generation of Tactical Deployment Plan for the region.

Data on Emergency (AS1) and Urgent (AS2) calls for the study period were generated automatically using the Ambulance service's Command & Control system, FORTEK. Patient Transport Service information was only available in a paper format and this was converted into a digital format by the Ambulance service. A number of data issues arose during the course of the project. A separate report on technical aspects of these is listed in Appendix 1 of this report.

Report Structure

Detailed findings under various sections are set-out in sections 2 to 6. Section 7 provides an executive summary of these findings, the study conclusions and a set of recommendations. A separate component of the analysis concerns data quality issues that arose in the course of the project, these are examined in Appendix 1, which also includes some recommendations on improving data quality.

Acknowledgments

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 Director of the National Hospitals Office (formerly Chief Ambulance Officer, HSE NW Area) initiated the study and was instrumental in its direction. We would also like to thank Pauric Sheerin, Acting Chief Ambulance Officer, HSE North West Area and his staff for their co-operation, valuable advice and support. Finally we would like to acknowledge the input from Mr. Tony Cummins, HSE NW Ambulance Communications Officer, whose diligence and skills in data compilation are a pre-requisite for studies of this nature.

2. EMERGENCY & URGENT INCIDENT DEMAND ANALYSIS

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

2.1 AS1 & AS2 Data Description

The records of AS1 and AS2 incidents were captured digitally within the FORTEK computer aided despatch system used by the North West Area Ambulance Service. 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. Basic details of the type of incident are recorded together with the address, and time of the call. For each viable incident the Ambulance service's resources are assigned. For some large incidents more than one resource may be assigned. 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 are made by the computer system that record the following:

Table 2.1

Time stamps available in Computer System	
Time Stamp	**Description**
Time of Call	Time call received by control operator
Creation Time	Time incident record created 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
Left Hospital Time	Time departs from hospital
Available Time	Time resource is available to undertake another assignment
Return Time	Time resource returns to its base

Computer system issues and operator practice had resulted in inconsistencies in data capture; these issues were resolved for the study. The specific data quality issues are examined in Appendix 1.

The total number of AS1 and AS2 calls used in the analysis was 10,648, of these there were a number of 'aborted' incidents and incidents that took place outside the region. The 'aborted' incidents are where the incidents were stood down; where it was a hoax call; or where it had been merged with another incident. In total there were 1,183 incidents classed as 'aborted'. These incidents are examined in the temporal analysis, as the project steering committee suggested that they represent an element of the demand for service. They were excluded from subsequent analysis concerned with resource performance, as often a resource was not subsequently 'assigned' or the resource was 'stood down' before it reached the incident scene. In addition to the 'aborted' calls, there were 29 incidents which took place outside the study region; these were handled separately in the resource analysis but were included in the temporal analysis as they impact on demand variability (see table 2.2).

Table 2.2

Incidents used in Study	
Incidents	**No.**
'Non-aborted' Incidents with spatial reference	9,436
'Non-aborted' Incidents outside region	29
'Aborted' Incidents with spatial reference	812
'Aborted' Incidents with no spatial reference	371
Total Incidents	**10,648**

2.2 Temporal Variability

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

2.2.1 Monthly Variation

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

Table 2.3

AS1 and AS2 calls by Month *(all incidents)*						
	Number of Incidents			Daily Average per Month		
Month	**AS1**	**AS2**	**All**	**AS1**	**AS2**	**All**
January	622	237	859	20.1	7.6	27.7
February	504	213	717	18.0	7.6	25.6
March	654	222	876	21.1	7.2	28.3
April	720	227	947	24.0	7.6	31.6
May	719	253	972	23.2	8.2	31.4
June	715	245	960	23.8	8.2	32.0
July	660	259	919	21.3	8.4	29.6
August	693	325	1,018	22.4	10.5	32.8
September	543	287	830	18.1	9.6	27.7
October	565	265	830	18.2	8.5	26.8
November	496	329	825	16.5	11.0	27.5
December	633	262	895	20.4	8.5	28.9
Total	**7,524**	**3,124**	**10,648**	**20.6**	**8.6**	**29.2**
Average per month	***627***	***260***	***887***			

From all incidents recorded there was an average monthly rate of 627 AS1 calls and 260 AS2 calls. In general the summer months have higher numbers of incidents than winter months. The month of August had the highest number of calls, although when this is broken down to a daily average by month it was only slightly higher than June, the next highest. The high August figures are primarily driven by increased numbers of AS2 calls; given that only one year of data was used in the study it is difficult to attribute reasons for this, however as indicated below in table 2.4. August also had a higher percentage of 'aborted' calls than other months. The lowest number of calls is in February, and this low rate of calls is also reflected in the monthly daily average indicating that this low number of calls is not merely a factor of the number of days in the month. Despite the variability between winter and summer months overall the figures suggest minimal variation between months and a relatively constant rate of incidents through the year for both AS1 and AS2 calls.

To establish a better idea of demand trends through the year it is necessary to include other years in the analysis; this was not possible for this study.

As stated above included in the figures in table 2.3 are the numbers of calls classed as 'aborts', table 2.4 below lists these by month. The average number of calls classed as 'aborted' was 99 per month or around 11% of all incidents. Variability was weighted toward summer time and August had the highest number at 15% of all incidents in that month. The increased number of 'aborted' incidents partly explains the increased incident rates noted for the summer months above.

Table 2.4

Aborts/ Hoaxes etc. calls by Month *(AS1 & AS2)*

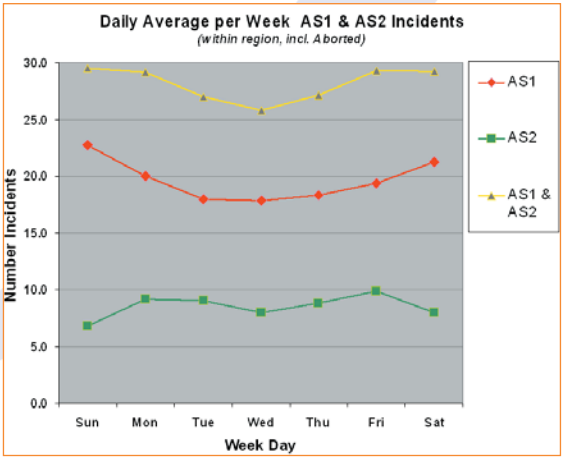
Month	Abort Type				Grade		By Month	
	G102 (Aborted)	M100 (N/A)	G103 (Hoax)	Other	AS1	AS2	Total	% of all Incidents
January	78	14	3	1	86	10	96	11.2%
February	53	7	3	1	55	9	64	8.9%
March	102	8	5	2	109	8	117	13.4%
April	79	5	2	2	82	6	88	9.3%
May	67	10	3	2	73	9	82	8.4%
June	61	7	4	3	69	6	75	7.8%
July	87	21	4	3	101	14	115	12.5%
August	110	30	7	9	135	21	156	15.3%
September	73	8	1	1	77	6	83	10.0%
October	88	4	3	2	84	13	97	11.7%
November	70	22	6	2	80	20	100	12.1%
December	93	12	3	2	95	15	110	12.3%
Total	**961**	**148**	**44**	**30**	**1,046**	**137**	**1,183**	**11.1%**
Average per month	***80***	***12***	***4***	***3***	***87***	***11***	***99***	***11.1%***

2.2.2 Weekly Variation

The daily rate of AS1 and AS2 incidents shows a distinct de-correlation of activity. The highest daily average AS1 incidents occurred during the weekend (Saturday & Sunday) with around 20 to 23 incidents. The lowest number of AS2 calls occurred during the weekend, but numbers rose strongly on Mondays. There was a slight dip in the number of AS2 calls on Wednesdays, and numbers rose again until Fridays (see figure 2.1).

Wednesdays therefore have the lowest total number of incidents with the combined total of AS1 and AS2 dipping to just over 25 calls.

Figure 2.1
Daily Averages of AS1 and AS2 incidents



2.2.3 Daily Variation

The average number of incidents reaches a peak at around 13.00 hrs each day for both AS1 and AS2 incidents. There is a steady increase in the number of incidents starting at around 7.00 hrs for AS1 and 8.00 hrs for AS2. At around 3.00 hrs in the morning there are also relatively high numbers of AS1 incidents, which falls off until 7.00 hrs (see figure 2.2). Both AS1 and AS2 incident rates decrease during the afternoon and evening, with rates of AS2 incidents falling more sharply.

As already noted there are different numbers of incidents at the weekend compared to weekdays, for this reason figure 2.3 and figure 2.4 examine incident rates for hours during the Weekend and hours during weekdays respectively.

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

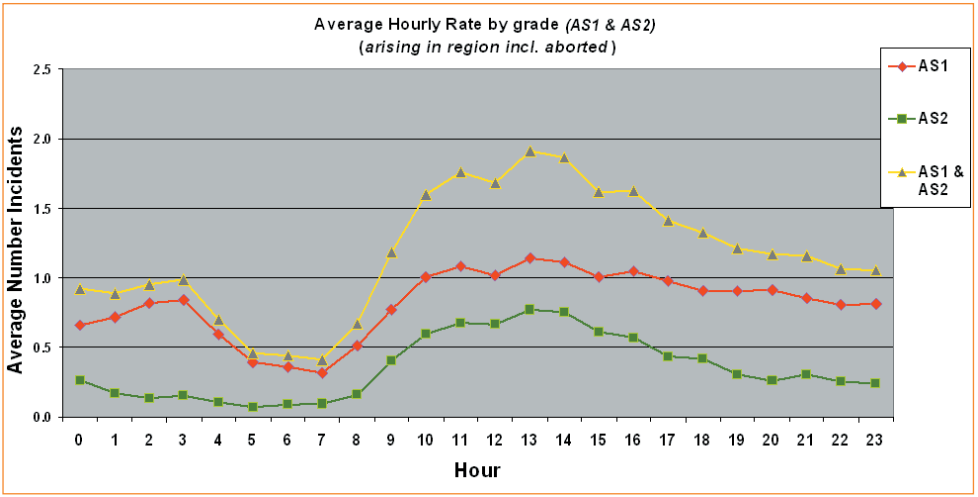


Figure 2.3 Average number of incidents per hour (Weekend only)

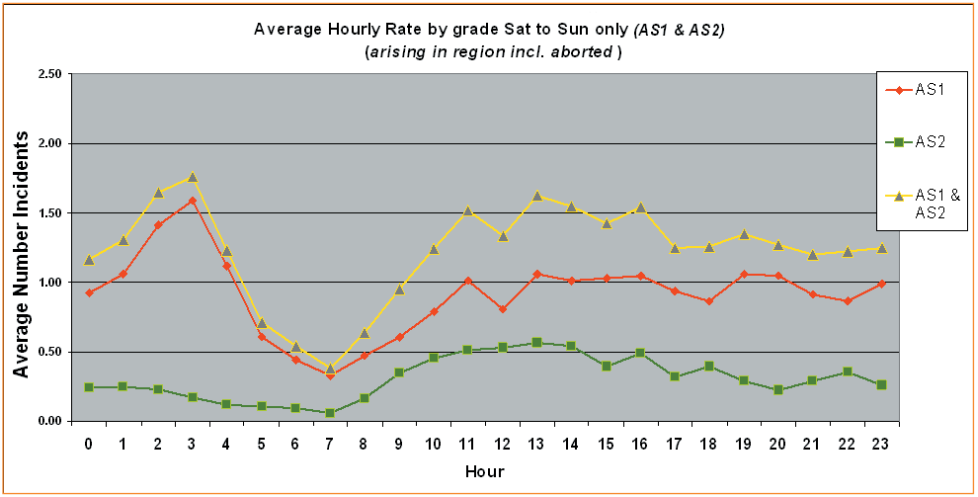
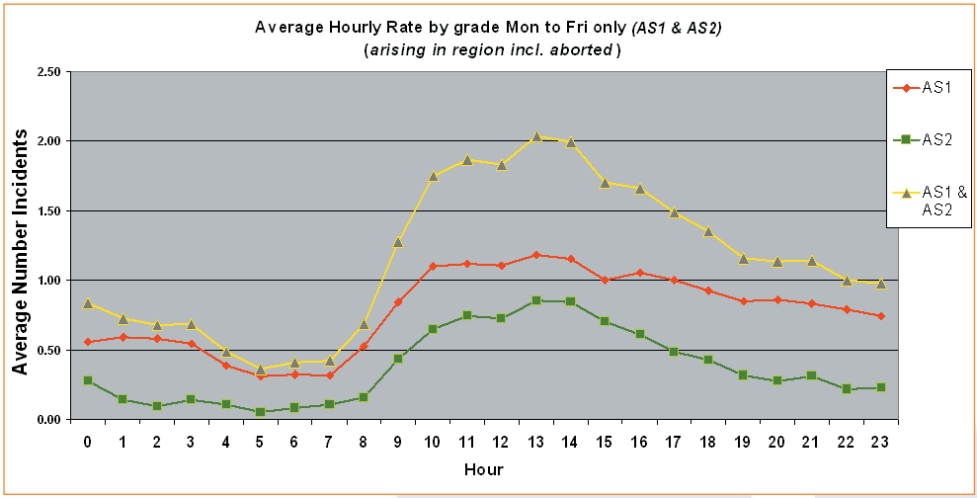


Figure 2.4 Average number of incidents per hour (Weekdays only)



A very different pattern of demand is apparent between weekdays and the weekend with firstly, higher rates of AS1 calls between 0.00hrs and 04.00hrs on Saturday and Sunday mornings occur than during on weekdays; secondly, higher rates of AS1 calls after 09.00hrs during weekdays than on weekends; and, thirdly, significantly higher numbers of AS2 calls between 08.00hrs and 16.00hrs on weekdays than during the weekend.

2.2.4 Temporal Variation Findings

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

- There is only minor variation on the monthly rates of incidents during the study period and while there were small increases apparent during the summer months these were relatively small when considered with the rates of 'aborted' incidents during those months.
- Significant variation of demand activity occurred between weekends and weekdays. The weekly profile of demand demonstrated that AS1 calls increased over weekends but reduced during the week. The AS2 calls showed highest levels of demand on Mondays and Fridays respectively.
- During the day the highest period of activity in weekdays occurred between 12.00 hrs and 16.00 hrs and this was principally dictated by the pattern of AS2 calls.
- At weekends highest levels of activity occurred between 00.00hrs and 04.00hrs with AS1 calls dominating the demand profile.

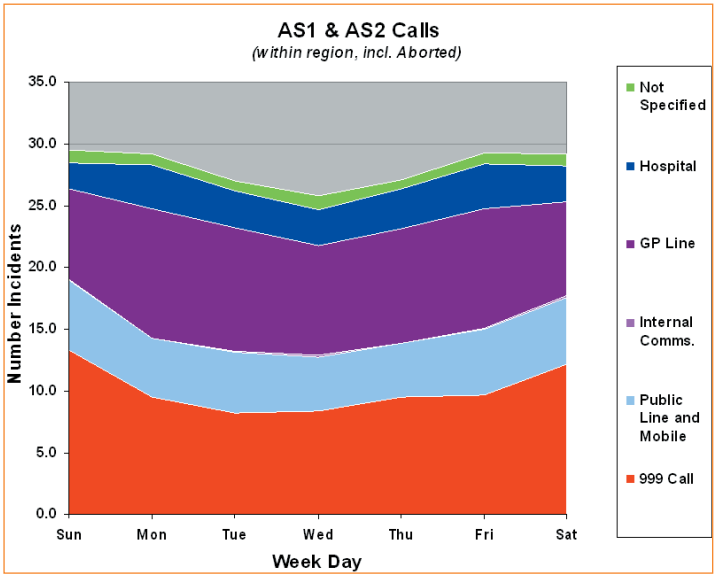
2.3 Call Source for AS1 & AS2 Incidents

The nature of the demand activity for AS2 activity suggests that it may be a product of management practices both in Hospitals and GP surgeries. Thus for example "decanting" of patients by hospitals on Fridays may influence the levels of AS2 activity apparent for Fridays, equally the high levels of AS2 demand around 13.00 hrs during weekdays may reflect how GP surgeries manage their patients as opposed to inherent need for urgent transport activity amongst the population as a whole. If patient management practices are influencing the demand profile there may be opportunities to re-arrange demand profile that can make better use of resources rather than for example having both the AS1 demand (which management practices should have little influence on) and AS2 demand peaks occurring at the same time.

To assist this facet of the temporal demand profile we can use the call source information collected by the

Ambulance controllers when recording incidents. For both AS1 and AS2 the majority of calls (36%) are derived from the 999 call system, followed by GPs (32%) and Hospitals (11%). These proportions however vary during the week with higher percentages of 999 calls during the weekend and correspondingly lower numbers of calls from GPs and Hospitals (see figure 2.5).

Figure 2.5 Call Source by Day



When weekend and weekday services for AS1 and AS2 calls are separated demand differences emerge that indicate that the majority of AS1 calls are derived from 999 sources with a demand peak at weekends, and that rates of GP calls diminish at weekends, in particular for AS2 calls. The demand peaks noted above for Mondays and Fridays for AS2 calls is primarily driven by calls from GPs (see figure 2.6)

Figure 2.6 Call Source by Day, AS1 only and AS2 only

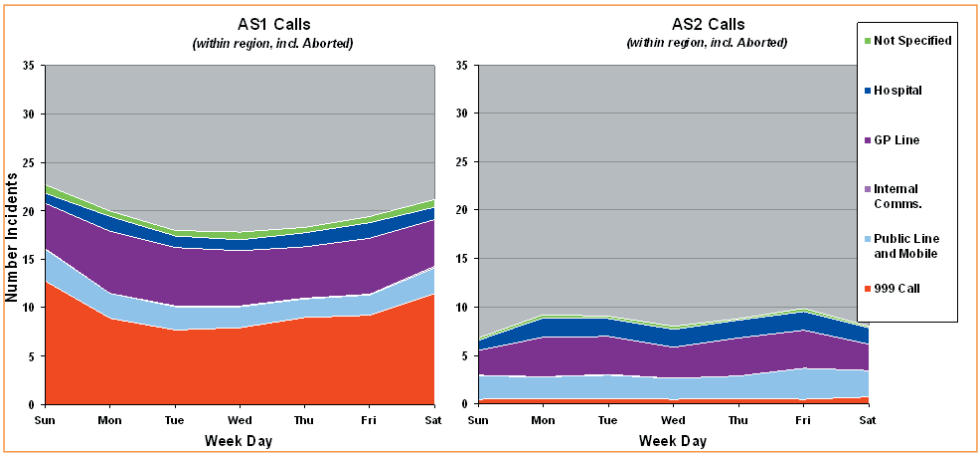


Figure 2.7 Call source by Hour (Monday to Friday)

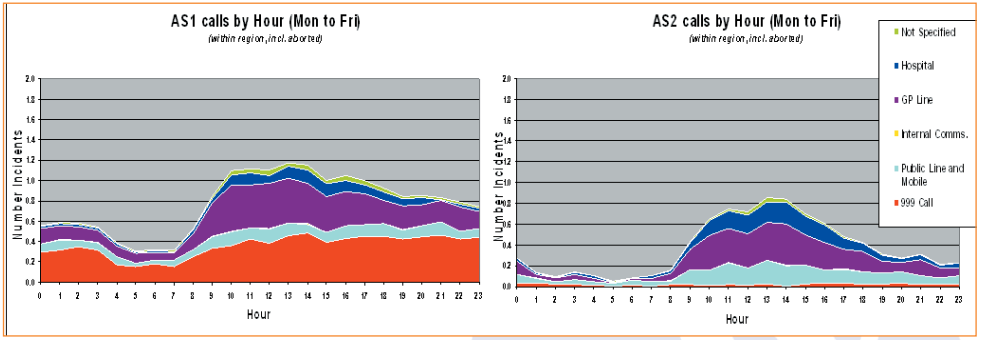
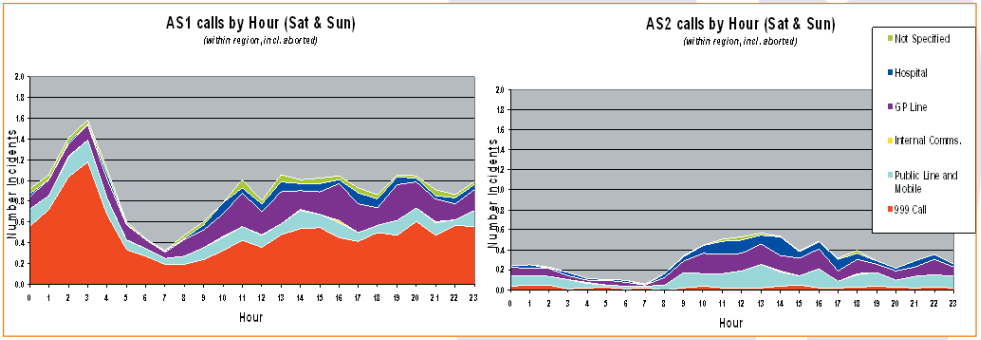


Figure 2.8 Call Source by Hour (Saturday & Sunday)



The daily variation in call sources is examined in figures 2.7 and 2.8, where the impact of both GP and Hospital requests for AS2 services both at weekends and during the week is apparent. There is clear service demand peak which occurs between 11.00 hrs and 15.00 hrs on weekdays and which is also coinciding with demand peaks arising from either 999 calls and calls from public lines.

It is beyond the scope of this current study to make recommendations regarding possible opportunities to influence demand for Ambulance services from hospitals or GP's. However we do recommend that further research be conducted to ascertain the nature of service requirements from those services with a view to identifying what opportunities exist to 'smooth' the service demand and thereby ensure that these demand peaks do not detract from resource availability on both weekly and daily basis.

2.4 Incident Types

The capture of incident types is made within the FORTEK system against a standard set of codes; in table 2.5 the 15 most commonly recorded incident types are listed.

Table 2.5 Record Incident Types

Rank	Incident Type	Code	AS2	% AS2	AS1	% AS1	Total	%
1	Chest Pain/Discomfort (C110)	A101	208	7%	966	15%	1,174	12%
2	Traumatic Injury (C129)	A115	337	11%	691	11%	1,028	11%
3	Respiratory Distress (C122)	A105	460	15%	566	9%	1,026	11%
4	Collapse/Syncope (C128)	A114	85	3%	546	8%	631	7%
5	Motor Vehicle Traffic Accident	A103	18	1%	603	9%	621	7%
6	Abdominal Pain/Problems	C101	306	10%	307	5%	613	6%
7	Seizure (C123)	A113	56	2%	335	5%	391	4%
8	Stroke/CVA (C127)	A107	149	5%	220	3%	369	4%
9	Vomiting	A126	125	4%	130	2%	255	3%
10	Emergency Transfer	E101	148	5%	96	1%	244	3%
11	Diabetic Symptoms (C111)	A106	93	3%	135	2%	228	2%
12	Poisoning/Drug Ingestion (C119)	A110	36	1%	183	3%	219	2%
13	Altered LOC (C104)	A109	41	1%	157	2%	198	2%
14	Query Fracture	A121	91	3%	95	1%	186	2%
15	Head Injury	A117	31	1%	145	2%	176	2%
	Top 15 Total		**2,184**	**73%**	**5,175**	**80%**	**7,359**	**78%**
	Other Incidents		**795**	**27%**	**1,282**	**20%**	**2,077**	**22%**
	Incidents (Non Aborts)		**2,979**	**100%**	**6,457**	**100%**	**9,436**	**100%**

These 'top 15' recorded incident types account for 78% of all responded incidents, with Chest Pain (code A101) being the highest at 12%. The incident types captured within the control system in the North West Area do not correspond to the incident and patient record system proposed by the Pre-Hospital Emergency Care Council. In the opinion of the steering committee the methods of capture and classifications of incidents listed for incident types has little clinical value. In particular the coding system used does not indicate whether incidents were 'life threatening'. This has important implications for subsequent analysis concerning response times and the proposed Tactical Deployment Plan (TDP). Thus results provided in table 2.5 can only be considered as a broad indicator of the types of incidents that the Ambulance service in the North West Area responds to and additional recording protocols are required to ensure that this information has clinical value to allow any conclusions to be drawn from it.

2.5 Spatial Analysis of AS1 & AS2 Incidents

The spatial analysis set 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.

2.5.1 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 (Sligo and Letterkenny)
- Towns with population in 2002 of over 1,000 persons (these towns have a 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).

On the basis of these criteria we map the region as per figure 2.9.

Figure 2.9 Regional Spatial Typology

In population terms the most current census in 2002 indicated that the entire region had a population of 222,762 persons. From 1996 to 2002 the population of the region increased by 5% (see table 2.7). A population growth of 11% from 1996 to 2002 was recorded for towns in the region where in addition to Sligo and Letterkenny there are 15 towns with a population greater than 1,000 persons (see table 2.6). Sligo with the largest population base of 19,735 persons had a population increase of 6.6% from 1996 and Letterkenny with a population of 15,231 in 2002, enjoyed the highest population in the region with a 27% increase in population. The strengthening of the urban population base in the region corresponds to national trends and has important implications for future emergency care provision.

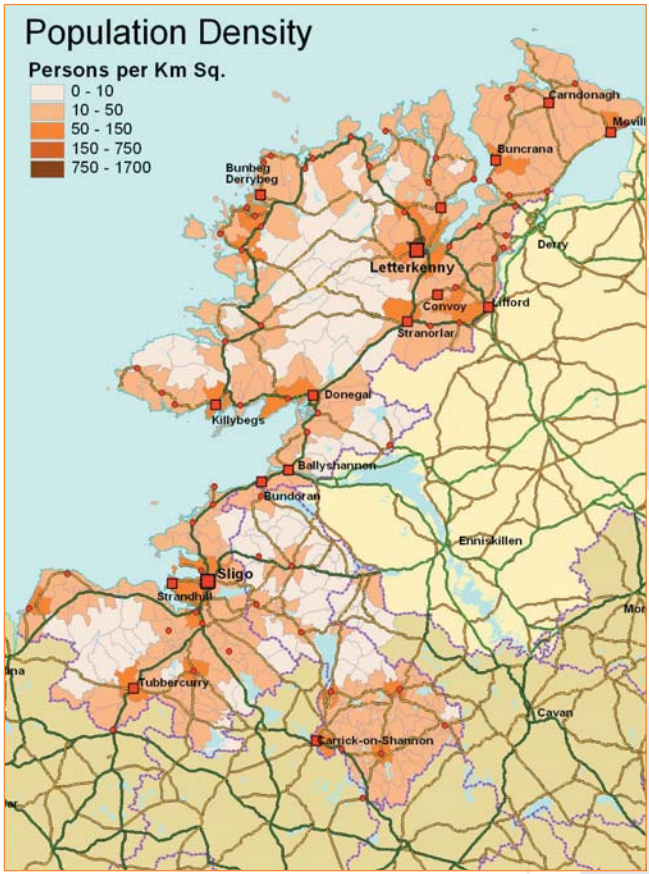
Table 2.6 Urban Population in HSE North West Area

Name	Total Population 1996	Total Population 2002	% Change
Donegal Towns			
Ballybofey-Stranorlar	3,047	3,603	18.2%
Ballyshannon	2,775	2,715	-2.2%
Bunbeg-Derrybeg	1,400	1,388	-0.9%
Buncrana	4,805	5,271	9.7%
Bundoran	1,796	1,842	2.6%
Carndonagh	1,580	1,673	5.9%
Convoy	907	1,028	13.3%
Donegal	2,296	2,453	6.8%
Killybegs	1,408	1,396	-0.9%
Lifford	1,275	1,395	9.4%
Moville	1,394	1,465	5.1%
Ramelton	978	1,051	7.5%
Towns & Villages (Donegal)	*23,661*	*25,280*	*6.8%*
Letterkenny	11,996	15,231	27.0%
Total Donegal	**35,657**	**40,511**	**13.6%**
Leitrim Towns			
Carrick-on-Shannon	1,868	2,237	19.8%
Total Leitrim	**1,868**	**2,237**	**19.8%**
Sligo Towns			
Strandhill	764	1,002	31.2%
Tubbercurry	1,089	1,171	7.5%
Towns & Villages (Sligo)	*1,853*	*2,173*	*17.3%*
Sligo Town	18,509	19,735	6.6%
Total Sligo	**20,362**	**21,908**	**7.6%**
Urban Total	**57,887**	**64,656**	**11.7%**

Note: See table 2.7 for rural population

The population density map in figure 2.10 highlights the distribution of population in the region, with four principal concentrations in the region; around Sligo and south to Tubbercurry; Letterkenny/Carndonagh; the coastlands from Donegal to Gortahork, and around Carrick-on-Shannon in Leitrim. These areas make up the main areas classified as rural, while the white areas in the map make up the sparsely populated, low population areas in the regional typology.

Figure 2.10 Population Density in the HSE North West Area



2.5.2 Spatial Distribution

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 2.7 which provides aggregations of each category of the area typology by county.

Table 2.7 Incidents (AS1 & AS2) within spatial typology

Name	Total Population		% Change	No. Incidents	All Incidents per 100 persons	AS1 incidents per 100 persons
	1996	2002				
Donegal						
Towns & Villages	35,657	40,511	13.6%	2,795	6.9	4.8
Rural Areas	86,273	88,880	3.0%	3,309	3.7	2.5
Low Density Rural Area [1]	8,064	8,184	1.5%	206	2.5	1.7
Total	**129,994**	**137,575**	**5.8%**	**6,310**	**4.6**	**3.2**
Leitrim						
Towns & Villages	1,868	2,237	19.8%	261	11.7	8.3
Rural Areas	19,216	19,484	1.4%	787	4.0	2.6
Low Density Rural Area [1]	3,973	4,078	2.6%	90	2.2	1.3
Total	**25,057**	**25,799**	**3.0%**	**1,138**	**4.4**	**2.9**
Sligo						
Towns & Villages	20,362	21,908	7.6%	1,712	7.8	5.7
Rural Areas	32,265	33,047	2.4%	982	3.0	2.2
Low Density Rural Area [1]	3,194	3,245	1.6%	60	1.8	1.3
Total	**55,821**	**58,200**	**4.3%**	**2,754**	**4.7**	**3.5**
Cavan (part)						
Towns & Villages	-	-	-	-	-	-
Rural Areas	647	568	-12.2%	33	5.8	3.7
Low Density Rural Area [1]	580	620	6.9%	13	2.1	0.8
Total	**1,227**	**1,188**	**-3.2%**	**46**	**3.9**	**2.2**
HSE N.W. Area						
Towns & Villages	57,887	64,656	11.7%	4,768	7.4	5.2
Rural Areas	138,401	141,979	2.6%	5,111	3.6	2.5
Low Density Rural Area [1]	15,811	16,127	2.0%	369	2.3	1.5
Total	**212,099**	**222,762**	**5.0%**	**10,248**	**4.6**	**3.2**
Sligo Town	18,509	19,735	6.6%	1,670	8.5	6.2
Letterkenny	11,996	15,231	27.0%	1,058	6.9	4.9

Notes:

1] Low density are areas with less than 10 persons per Km.

The results indicate average rates of incidents per head of population, where for the region as a whole there were 4.6 incidents per 100 persons, this is made up of 3.2 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 6.2 AS1 incidents per 100 persons in Sligo town compared with 2.5 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.

It is difficult to be definitive about the causes of this difference in demand for emergency care services between urban and rural populations, 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.

3. PATIENT TRANSPORT SERVICES (PTS) DEMAND ANALYSIS

3.1 PTS Data Description

Records of Patient Transport Services for the study period were not available in digital form and required conversion from paper records (AS3 forms). This was undertaken by staff in the HSE North West Area Ambulance service using the FORTEK system. The paper records were found to be of inconsistent quality with variation in how different time stamps were recorded and in the address names used to locate particular incidents. An exercise undertaken by Spatial Planning Solutions in association with the Ambulance service provided consistent address points for incidents and modelled relevant time stamps for service activity.

The principal time and location data items available from this exercise were;

Table 3.1

Data Items Used in Patient Transport Analysis	
Item	**Description**
Call Sign & Base Station	Ambulance Used and Base Station Location
Pick-up Point	Patient Address
Destination Point	Location of transport destination
Start Time (Mobile Time)	Time the resource leaves its station
Pickup Time	Time of arrival at the pick-up location
Destination Time	Time of Arrival at Destination (Appointment Time)
Clear & Available Time	Time Resource is available for other activity
Return Time	Time resource returns to base

In total 6,451 records were captured for the study period, the total number of PTS incidents where Ambulance only calls were made and where the base station was identifiable was 6,403 (the remainder being a small number of taxi records that were included in the data capture exercise). Of these all had Pickup points and Destination points (provided as address and converted to National grid co-ordinates). Time stamps were also attributable to these records, using destination time (time of appointment) where appropriate.

In addition to location and temporal data, information on patient type and incident were reported on the AS3 forms. These indicated using yes/no the following;

Table 3.2

Patient Type & Incident Type Information	
Patient Type *Indicated if Patient*	**Incident Type** *Indicated if transport was for*
Required Stretcher	Transfer
Required Wheelchair	Day Clinic (usually incl. Return)
Was Ambulatory	Hospital Admission
	Hospital Discharge
	Return From Clinic (new incident)

Only PTS records that utilised Ambulance resources were converted into a digital format and analysed. A considerable amount of patient transport services uses private taxi services, these were not included in the analysis since our concern was primarily on how PTS services impact on resource availability and provision of resources for AS1 and AS2 services.

3.2 Temporal Analysis

In total there were 6,403 separate PTS incidents during the year of the study period. The breakdown of these by month is listed below in table 3.3. On average 534 PTS incidents per month or 17.5 per day. Monthly totals were relatively constant through the year, with only a slight increase in November with 629 PTS incidents. The average of 17.5 per day was found to have somewhat more variability, with April the lowest at 15.5 PTS incidents and November the highest at 21 PTS incidents.

Table 3.3

PTS calls by Month

Month	Calls	% of Total	Daily Average per Month	No. Days
January	519	8%	16.7	31
February	480	7%	17.1	28
March	593	9%	19.1	31
April	469	7%	15.6	30
May	589	9%	19.0	31
June	498	8%	16.6	30
July	479	7%	15.5	31
August	562	9%	18.1	31
September	528	8%	17.6	30
October	535	8%	17.3	31
November	629	10%	21.0	30
December	522	8%	16.8	31
Total	**6,403**	**100%**	**17.5**	**365**
Average p/Month	***534***			

To establish a better idea of demand trends through the year it is necessary to include other years in the analysis, this was not possible for this study.

3.2.1 Weekly Variation

During the course of a week the number of PTS incidents dropped sharply at weekends and nearly all PTS services take place on weekdays. Figure 3.1 graphs the weekly incident rates of PTS calls together with AS1 and AS2. The day with the highest number of calls is Wednesday with around 25 incidents, but as can be seen numbers of PTS incidents for Saturdays and Sundays fall to less than 5.

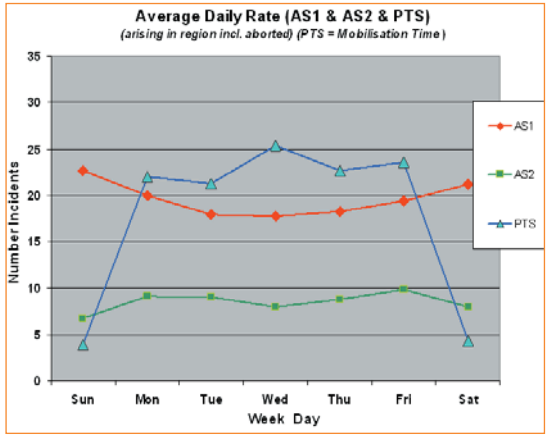
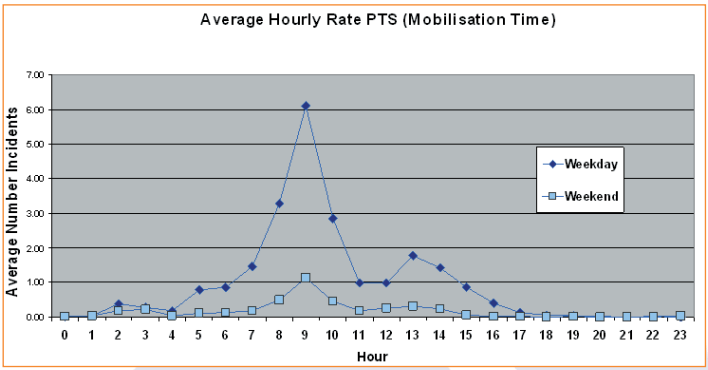


Figure 3.1
Daily Average of PTS calls per week.

3.2.2 Daily Variation

During weekdays the daily variation of PTS activity displays a very strong peak in mobilisation at 09.00 hrs with another smaller peak around 13.00 hrs (see figure 3.2).

Figure 3.2
PTS Mobilisation times for Weekday & Weekends



The peak in activity reflects the requirements to get patients to hospitals for their appointment times which are largely between 10.00hrs and 11.00hrs. Earlier at between 05.00hrs and 06.00hrs the increase in activity reflects the early starting time for transport of patients to, or from Dublin.

During the weekend activity levels diminish considerably but the 09.00 hrs peak is clearly apparent.

3.3 Patient Type & Activity Description

There is only a limited amount of information on patient condition recorded on the AS3 forms associated with PTS services. Information consistently reported on the AS3 forms primarily concerns the mobility status of PTS patients. In table 3.4 these are broken down by base station for all incidents. It is clear that the majority of patients are being classified as 'requiring a stretcher', with less than 6% being classed as 'ambulatory' and 1% 'requiring a wheelchair'. The implication from these figures is that most ambulatory are being transported by taxi services used in PTS activity. Reliance on these figures is difficult however as the data definition of how stretcher based PTS incidents are determined is unclear from the patients transport records (AS3 forms). As in the case of AS1 and AS2 incidents information on patient type requires better definition to draw definitive conclusions.

Table 3.4

PTS Services by Station and Patient Type

Base Station	Incidents Served	% Total	Patient Type			
			% Stretcher	% Ambulatory	% Wheelchair	% N/A
Sligo	2,534	39.6%	79%	10%	3%	7%
Letterkenny	1,354	21.1%	90%	3%	0%	6%
Manorhamilton	406	6.3%	91%	3%	0%	7%
Killybegs	351	5.5%	88%	2%	1%	9%
Donegal	312	4.9%	93%	1%	0%	6%
Cardonagh	303	4.7%	87%	4%	0%	8%
Lifford	288	4.5%	92%	0%	0%	8%
Dungloe	261	4.1%	90%	2%	0%	8%
Carrick on Shannon	234	3.7%	88%	2%	1%	9%
Ballyshannon	217	3.4%	89%	3%	0%	8%
Stranolar	143	2.2%	87%	0%	1%	12%
Total	**6,403**	**100%**	**86%**	**6%**	**1%**	**7%**

Also recorded on the AS3 form is information on the nature of the appointment or the type of PTS trip (see table 3.5). Data is again broken down by base station of the particular resource that undertook the PTS incident. The majority of PTS incidents undertaken by Ambulances were either Transfers from one hospital to another or they concerned patient transport for a Day Clinic. While on some AS3 forms the particular hospital department where patients were being transported to was recorded, the records were incomplete and it was not possible to utilise this limited information.

Table 3.5

PTS Services by Station and Incident Transport type					
Base Station	**Incident Type**				
	Transfer	*Day Clinic*	*Admission*	*Discharge*	*Return*
Sligo	*40%*	*52%*	*4%*	*2%*	*2%*
Letterkenny	*48%*	*43%*	*4%*	*4%*	*2%*
Manorhamilton	*57%*	*29%*	*9%*	*4%*	*1%*
Killybegs	*59%*	*26%*	*8%*	*7%*	*1%*
Donegal	*58%*	*33%*	*6%*	*2%*	*0%*
Cardonagh	*55%*	*31%*	*9%*	*4%*	*1%*
Lifford	*26%*	*61%*	*9%*	*0%*	*3%*
Dungloe	*40%*	*49%*	*4%*	*7%*	*1%*
Carrick on Shannon	*58%*	*26%*	*10%*	*5%*	*0%*
Ballyshannon	*37%*	*50%*	*5%*	*6%*	*1%*
Stranolar	*47%*	*39%*	*8%*	*5%*	*1%*
Total	*45%*	*44%*	*6%*	*3%*	*2%*

From the amount of Day Clinic transport involved it is possible to suggest that much of this activity will be known for some time in advance of the requirement to transport patients. This information may be used to plan in advance when patients are due for clinics and better co-ordinate the use of Ambulance resource to undertake this and perhaps spread the use of Ambulance resources throughout the day / week and avoid some of the peaks in emergency resource demand.

Table 3.6 lists the relationship between Incident types and Patient types (mobility status). Of note in this table are the numbers of Ambulatory patients that were transported on Ambulances for Day Clinics. While this suggests that not all patients require the use of Ambulances for transport, the absence of better information on patient condition concerning their movement status and their particular hospital requirements renders it difficult to make any firm recommendations other than highlight the need for more robust data definitions and consistent recording of that information.

Table 3.6

Incident Types and Patient Type (Crosstab)					
Incident Type	**Ambulatory**	**Stretcher**	**Wheelchair**	**Not Listed**	**Grand Total**
Admission	2	311	1	43	357
Day Clinic	207	2,359	60	193	2,819
Discharge	45	158	2	17	222
Return	5	86	4	12	107
Transfer	94	2,571	20	213	2,898
Total	***353***	***5,485***	***87***	***478***	***6,403***

For a cross-tabulation of Incident type and patient types by pick-up location see appendix 3.

3.4 Spatial Patterns of PTS Activity

The broad patterns of PTS activity is analysed firstly in relation to the Area Typology utilised above. Table 3.7 identifies the sources or collection points of PTS incidents. Clearly apparent from this table is the strong bias toward Sligo and Letterkenny. This bias is primarily a function of the majority of pick-ups being from the Hospitals in Letterkenny and Sligo.

Table 3.7

PTS Services (Pick-up) in Area Typology

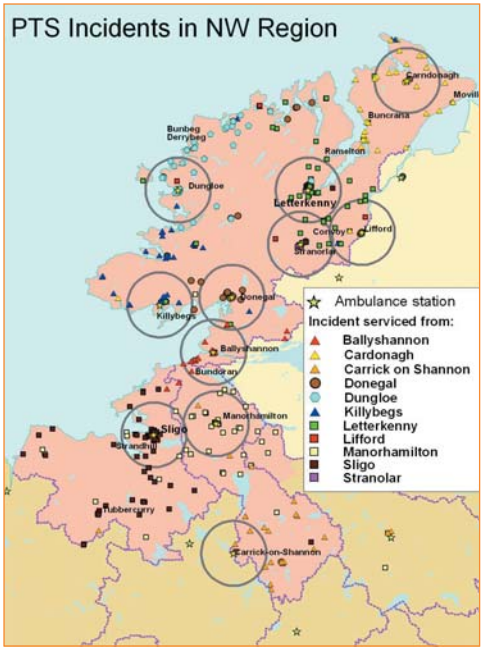
Pickup Location	No PTS Incidents	% PTS Incidents (total)	% PTS Incidents (in Region)
Rural (High)	760	11.9%	*12.6%*
Rural (Low)	55	0.9%	*0.9%*
Urban	524	8.2%	*8.7%*
Letterkenny	*2,045*	31.9%	*33.8%*
Sligo	*2,669*	41.7%	*44.1%*
Regional Total	***6,053***	***94.5%***	***100%***
Other Locations			
Dublin	301	4.7%	
Galway	15	0.2%	
NEHB & NIAS	34	0.5%	
Total Records	**6,403**	**100.0%**	

In addition to pickup locations in the North West Area, 350 PTS incidents had pick-up points outside the region in Dublin, Galway and parts of Northern Ireland (mostly Altnagelvin Hospital).

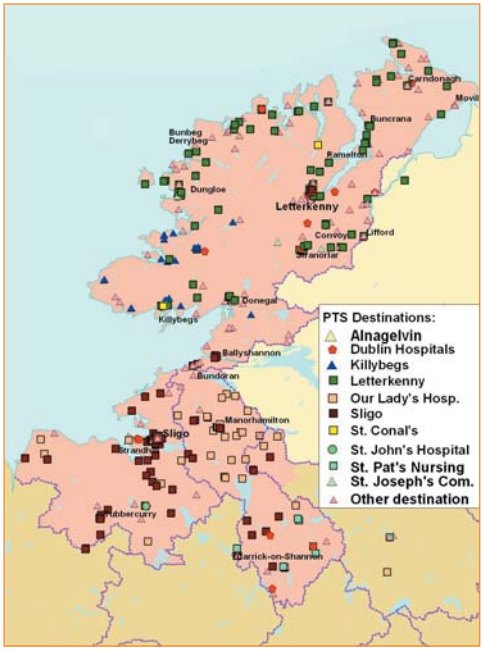
The distribution of pick-up locations for PTS incidents is mapped in Figure 3.2, where the base station of each pick-up point has also been indicated (A) and Destination points (B). The distribution of pick-up points broadly clusters around respective ambulance Stations, although there are some notable outliers, which may be a consequence of limited resource availability at a particular time resulting in Ambulances from more distant stations being assigned to a particular PTS incident. It is important to note however that not all Ambulances started their journey at their base station as some PTS journeys would be assigned to an Ambulance while in the course of either returning to a base station or as a multiple PTS activity trip. Information on the location of an Ambulance when it is assigned is not recorded in the current system configuration. This aspect of the data collection system is one of the recommendations of this report. Despite this the nesting of most PTS incidents around respective stations does suggest that most incidents are assigned to Ambulances while located in their stations.

For some stations, e.g. Killybegs, travel distances to pick-up points are considerably longer than for other stations, reflecting different geographic catchments.

Figure 3.2 PTS Incidents in NW Area (Pick-up and Destination)



(a) Pick-up locations by Base



(b) Pick-up by Destinations (top 10)

Table 3.8

Travel Distance (in NW Area only) [1]					
Station Name	% PTS Incidents from Base Station	Kilometres [2]			Average Total Annual Distance (1000s KM)
		Average Pick-up Trip Distance	Average Pick-up to Destination Trip Distance	Total Average Trip Distances	
Killybegs	6%	38.3	41.8	80.1	26.3
Donegal	6%	33.9	39.7	73.6	22.1
Cardonagh	6%	30.0	28.9	58.9	17.4
Carrick on Shannon	4%	27.2	36.3	63.5	13.9
Lifford	1%	20.4	25.2	45.6	2.5
Dungloe	5%	18.8	33.0	51.7	13.4
Stranolar	1%	16.4	20.7	37.1	1.8
Ballyshannon	4%	14.6	29.2	43.7	9.0
Manorhamilton	7%	14.1	19.6	33.7	12.6
Letterkenny	22%	5.1	19.6	24.7	28.4
Sligo	39%	2.9	7.1	10.0	21.2
Regional Average	**100%**	**12.1**	**19.5**	**31.5**	**168.6**

[1] Excludes trip to Dublin and other HSE Areas
[2] Distance is straight line distance between Station to Pick-up to Destination

Table 3.8 captures the variation of travel distances from base stations to pick-up points and onwards to destinations. Although the figures in table 3.8 are indicative only, in that distances are based on the straight line distance from each station to pick-up point and destination point, nonetheless, they provide a useful indicator of activity levels that takes into account the spatial distribution of demand for PTS services.

Sligo has the lowest total travel distance reflecting the amount of travel between Sligo General Hospital and the nursing homes and care institutions within or close to Sligo town. A similar pattern can be attributed to Letterkenny. The higher average 'destination' distance or trips from Ambulances stationed in Letterkenny are partly attributable to the number of trips to Sligo General Hospital. The significantly higher travel distances for Killybegs, Donegal, Carrick-on-Shannon and Dungloe reflecting the dispersed nature of the population in their catchment and the extra distances to get to the principal destinations of Sligo and Letterkenny. In total there were 142 different pick-up points for PTS that used Ambulances, of these 51 locations had only one or two pick-up incidents.

Letterkenny had the highest number of travel kilometres with 28.4 thousand kilometres followed by Killybegs. The high level of activity is a function of the greater geographic dispersion of population serviced from Letterkenny Hospital, as is illustrated by the significantly longer average destination distance compared with the pick-up distances in Letterkenny.

Trips to Dublin are excluded from the figures in table 3.8, however these trips make up a significant amount of PTS activity. In total 1000 trips either as pick-up or as destination were made. The stations where Ambulances were based for these trips is listed below in table 3.9.

Table 3.9

Dublin Travel Distance [1]

Station Name	No. Incidents	Total Average Trip Distances (Km) [2]	Average Total Annual Distance (1000s Km)
Sligo	391	237	92.8
Lifford	233	257	59.8
Letterkenny	186	310	57.8
Stranolar	94	275	25.9
Manorhamilton	28	258	7.2
Killybegs	23	357	8.2
Carrick on Shannon	15	215	3.2
Donegal	12	293	3.5
Ballyshannon	10	267	2.7
Cardonagh	7	356	2.5
Dungloe	1	237	0.2
Regional Average	**1,000**	**264**	**263.8**

[1] Where Dublin is either Pick-up Point or Destination

[2] Distance is average straight line distance from Station to Pick-up points to Destination

[1] In total there were 699 trips from the NW area to Dublin and 301 pick-ups made from Dublin. . Galway 40 PTS trips from the NW Area and there were 15 Pick-ups made from there.

Ambulances based in Sligo, Lifford, Letterkenny and Stranolar stations make up the majority of the resources used for Dublin trips (87.4% of all trips). The average Trip distances include the travel distance from station to pick-up point and onwards to destination. Again these are intended to act as indicators of activity levels and not as totals for individual mileage of any particular resource or station.

In total trips to 151 different destinations were made during the study period, the top 15 most frequent destinations are listed in table 3.10. The most frequent trips are to the general hospitals in Sligo and Letterkenny, they account for 40.6% of all trip destinations. Following these are trips to Dublin, with 699 trips, or 10.9% of all trip destinations.

Table 3.10

Top 15 PTS Destinations

Rank	Destination	No Incidents	% Incidents
1	Sligo Regional Hospital	1,666	26.0%
2	Letterkenny General Hospital	932	14.6%
3	Dublin	699	10.9%
4	Saint Johns Hospital	315	4.9%
5	Our Ladys Hospital	242	3.8%
6	Killybegs Community Hospital	181	2.8%
7	Saint Conals Hospital	168	2.6%
8	St Pats Nursing Unit	137	2.1%
9	Altnagelvin Hospital	136	2.1%
10	St Josephs Community Hospital	112	1.7%
11	Lifford Community Hospital	110	1.7%
12	Nazareth House	108	1.7%
13	Shiel Hospital	95	1.5%
14	Dungloe Community Hospital	94	1.5%
15	Carndonagh Community Hospital	93	1.5%
	Other	*1,315*	*20.5%*
142	**Total**	**6,403**	**100.0%**

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

- That the Ambulances based in Killybegs, Donegal, Dungloe, Carrick-on-Shannon and Carndonagh have high activity levels due to their peripheral location and large catchments.
- High levels of activity for Ambulances based in Manorhamilton appear to be related to relief activities for services from Sligo as opposed to serving local population.
- The majority of PTS activity concerns moving patients either to or from Letterkenny and Sligo.
- Trips to and from Dublin represent a high proportion of PTS activity in the region

4. PERFORMANCE ANALYSIS

4.1 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 on 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 West Area, 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 8 minutes
- Respond to 95% of 'Cat A' calls within 14 minutes (urban) and 19 minutes (rural)
- Respond to 95% of 'Cat B' calls within 14 minutes (urban) and 19 minutes (rural)

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

Urban areas are defined as areas where population is greater than 100 persons per Km^2 (2.5 persons per acre) in 1991, and rural areas where population density is less than 100 persons per Km^2. In Scotland three spatial definitions are used, High Density (more than 120 persons per Km^2), Medium Density (less than 120 per Km^2 but more than 20 persons per Km^2) and Sparse Density (less than 20 per Km^2).

Ireland's settlement structure and urban hierarchy is significantly different to the UK and direct translation of these definitions of urban and rural locations may not be appropriate. In the case of the North West Area 59% of the area has a population density of less than 20 persons per Km^2 and 22% of the total population resided in those areas. Furthermore the distinction between Category 'A' and Category 'B' calls are not equivalent to the distinction between 'AS1' and 'AS2' incidents in the Irish context. Direct comparison of the results of the performance analysis presented here with other jurisdiction is therefore not possible.

In section 2.4 of this report 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 North West Area 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 8 minute response time for greater than 50% of 'Life Threatening' AS1 incidents.

4.2 Response Times in North West Area

The average response time for the study period for the entire NW Area was 18.1 minutes for all AS1 & AS2 incidents. For AS1 the average response time for all incidents was 15.5 minutes and 26.0 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.

4.2.1 Response Time – 8 Minutes

For the entire region 27% of all AS1 incidents are responded to in under 8-minutes. In the principal urban centre of Sligo this rises to 60% of all AS1 incidents whereas in rural locations 11% of AS1 calls were responded to in 8 minutes. Percentages for AS2 calls are substantially smaller (see table 4.1).

Table 4.1

Under 8 minute Response time *(Percentage Incidents)*			
NW Area	**Emergency (AS1)**	**Urgent (AS2)**	**All Incidents**
Sligo Town	60%	30%	52%
Letterkenny	54%	26%	46%
Towns & Villages	28%	21%	26%
Rural[1]	11%	7%	10%
All Localities	**27%**	**15%**	**24%**

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 work load is likely to be overstated for the region.

Across the region there is significant variation in responsiveness reflecting settlement patterns and incident demand criteria as described earlier (see table 4.2). There is a higher percentage of incidents responded to in the towns and villages in Donegal compared to Sligo which has a less nucleated settlement pattern compared to Donegal. 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.

[1] The rural areas are all areas outside towns and villages, the sparsely populated areas have been amalgamated into the rural areas in this instance.

Table 4.2

Under 8 minute Response time *(Percentage Incidents)*			
County / Locality	**Emergency (AS1)**	**Urgent (AS2)**	**All Incidents**
Donegal			
Letterkenny	54%	26%	46%
Towns & Villages	26%	19%	24%
Rural	11%	7%	10%
County Average	***22%***	***13%***	***19%***
Leitrim			
Towns & Villages	44%	40%	43%
Rural	15%	13%	14%
County Average	***22%***	***18%***	***21%***
Sligo			
Sligo Town	60%	30%	52%
Towns & Villages	12%	0%	6%
Rural	7%	3%	6%
County Average	***39%***	***19%***	***34%***
Cavan (part)			
Towns & Villages	-	-	-
Rural	0%	0%	0%
County Average	***0%***	***0%***	***0%***
All Localities	**27%**	**15%**	**24%**

4.2.2 Response Time – 14 and 19 Minutes

Substantially more incidents are responded to in the region within 14 minutes with 46% of all AS1 calls in the region being within the response time. Letterkenny town had the highest gain of incidents achieving this target compared with the 8 minutes target.

Table 4.3

Under 14 minute Response time *(Percentage Incidents)*			
NW Area	**Emergency (AS1)**	**Urgent (AS2)**	**All Incidents**
Sligo Town	79%	53%	72%
Letterkenny	78%	40%	67%
Towns & Villages	49%	37%	45%
Rural	27%	15%	24%
All Localities	**46%**	**28%**	**40%**

At nineteen minutes 88% of all AS1 incidents and 81% of all incidents were responded to in Sligo town; Letterkenny had a similarly high level of responsiveness for AS1 calls but had just 46% of AS2 calls met within this timeframe, resulting in 75% of all calls being responded to in 19-minutes. For the region as a whole 59% of AS1 calls were responded to in 19-minutes (see table 4.4).

Table 4.4

Under 19 minute Response time *(Percentage Incidents)*			
NW Area	**Emergency (AS1)**	**Urgent (AS2)**	**All Incidents**
Sligo Town	88%	62%	81%
Letterkenny	86%	46%	75%
Towns & Villages	61%	47%	57%
Rural	43%	25%	37%
All Localities	**59%**	**37%**	**52%**

4.2.3 Response Time – 25 Minutes

The final time-frame to be examined in this section are figures for 25 minutes response time. This response time has been included as it corresponds to other work undertaken by PHECC concerning theoretical response times based on drive-time models of Ireland[2]. In total 73% of all AS1 incidents were responded to within the 25-minute timeframe and 65% of all emergency incidents. Whereas over 90% of all AS1 incidents in Sligo and Letterkenny were responded to within 25-minutes, longer drive-times for rural locations resulted in 61% of AS1 incidents being responded to in less than 25-minutes.

Table 4.5

Under 25 minute Response time *(Percentage Incidents)*			
NW Area	**Emergency (AS1)**	**Urgent (AS2)**	**All Incidents**
Sligo Town	92%	70%	86%
Letterkenny	90%	54%	80%
Towns & Villages	79%	59%	73%
Rural	61%	38%	54%
All Localities	**73%**	**48%**	**65%**

The theoretical analysis using drive-time, concluded that 8.4% of the population (some 19,372) people resided outside the 25-minute response time target used in that study. Although results between the drive-time model and those using real incident records cannot be compared directly, it is apparent that the drive-time model has overestimated the current capacity of the North West Area to achieve high levels of responsiveness in less than 25-minutes. This result was anticipated in the study on drive-time as the assumptions used in the model, where; (a) the nearest ambulance station served the relevant population; and, (b) an Ambulance resource was always available; are not always valid.

[2] Moore, D. National Spatial Analysis – Ambulance Service: compilation as related to road traffic . . accidents and population. Naas: Pre-Hospital Emergency Care Council, 2005. (Publication pending).

5. TACTICAL DEPLOYMENT PLANNING (TDP) AND RESOURCE ASSESSMENT

5.1 Description of Goals of TDP

5.1.1 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.

5.1.2 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 Ordnance Survey Ireland data provided by the Ambulance service of the HSE NW Area. The road network is derived from the OS 1:50k 'Discovery Series', and was slightly out of date, but these are intrinsic weaknesses in the OSI data products. On balance, the road network data was considered to be fit for the purpose in hand.

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 on 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 NW Area to the Ambulance service is one of the key deliverables of the project.

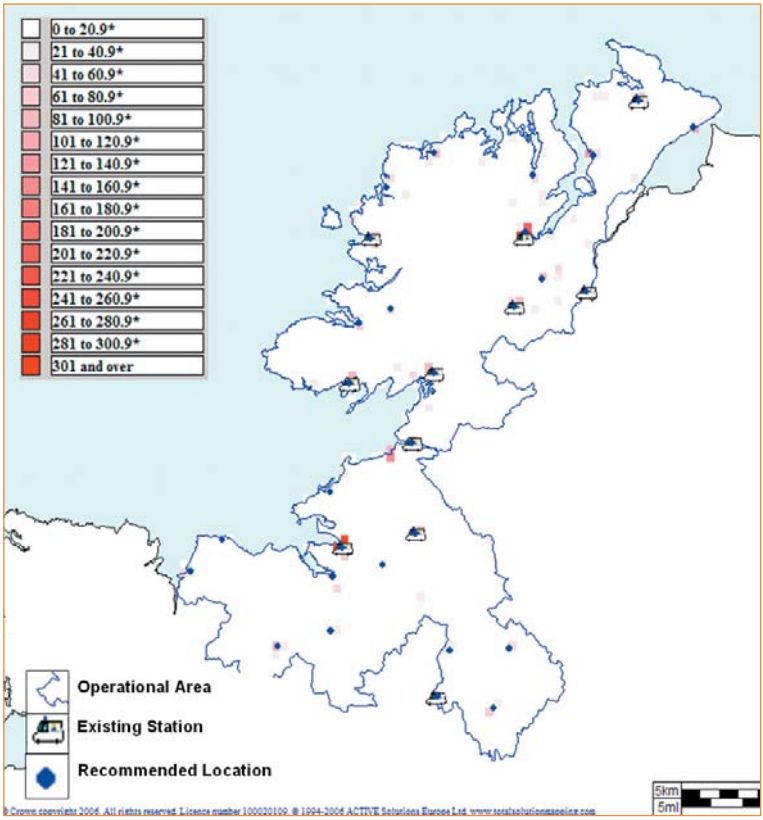
The fundamental configuration patterns recommended within the TDP for the NW Area is contained within this package which provides the best means of examining its components. In the following sections we describe some of the key features of the TDP, its creation, the assumptions within the plan, and distribution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

5.2 TDP – Steps in Creation

5.2.1 Identify Best Vehicle Positions and Compare with Existing Stations

Using ACTIVE TSM loaded with the data provided by SPS, hotspot maps of demand have been created. AS1, AS2 and PTS calls between 01/07/2004 and 29/06/2005 are separately analysed, and counted firstly into 3km grid squares, from where the 500m concentration of demand within each "hot" 3km grid square can be found. Once the 500m hotspots are identified, a suitable point on the road network on which to stand by can be selected within the immediate vicinity, usually a fast road or crossroads to maximise response potential. This methodology identifies **Response Origins** across the operational area. This method and the Response Origins were agreed by the steering group during the course of the project and before proceeding to the next steps.

Figure 5.1 Shows the locations of existing stations and recommended demand based Response Origins. 3km grid squares are coloured from white to red to show the density of incidents

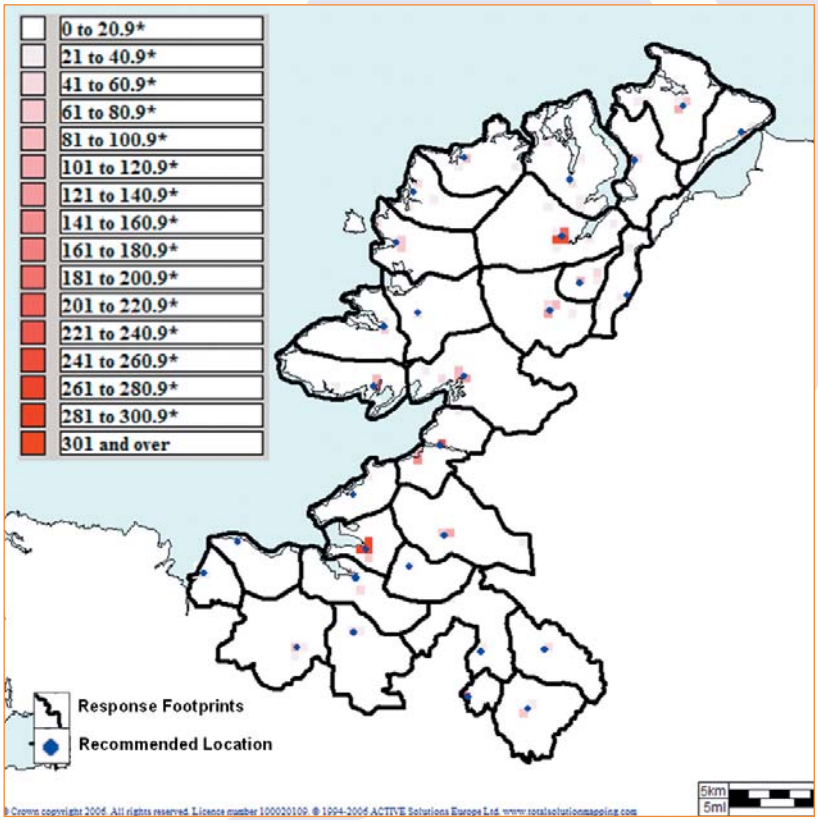


5.2.3 Response Footprint Formation

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 veracity. 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. As stated above, these were reviewed by the steering committee in the NW 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 5.2 Shows the locations of recommended demand based Response Origins and Response Footprints around each. 3km grid squares are coloured from white to red to show the density of incidents.



A listing of the 29 recommended Response Origins is provided in Appendix 2 and are mapped above in figure 5.2. All current Ambulance stations are considered as a response origin (11 stations) together with the locations currently deploying Rapid Response Vehicles (RRV) (2 locations). In addition to these there are 16 additional response origins recommended. It is recommended that the precise position of these origins within the footprint area be identified in conjunction with staff and correspond to suitable locations where facilities (such as toilet and rest areas) are available, for example at GP co-op centres or other HSE NW sites.

5.2.4 Tactical Deployment Plan

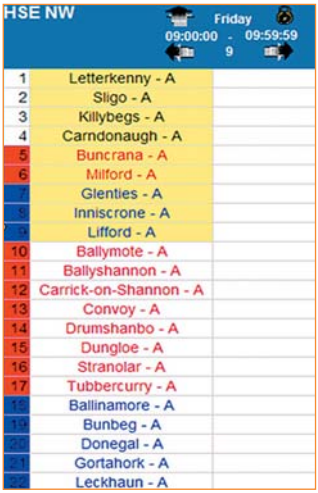
The TDP Viewer™ contains prioritised lists of Response Origins based on the amount of demand for each hour of the week. Each vehicle is allocated to a Response Origin based on the demand in its Response Footprint. This means some Response Origins may have two or three resources, if warranted, in some 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.

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 good working knowledge of the geography of the operational area to ensure that post to post movements are prudently instructed.

The sample plan at Figure 5.3 is for Friday 09:00 hrs – 09:59 hrs. Each location is listed in priority order based on the demand in this hour, and the letters in brackets represent the vehicle sequence at a location, for example (A) equals first vehicle, (B) equals second and so on. There are nine resources available to the dispatcher for this period. 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 that most closely reflects demand patterns. Decisions on deployment are left to the individual dispatcher with guidance for optimum deployment provided by the TDP.

Figure 5.3 TDP on Friday 09:00 hrs to 09:59 hrs



5.3 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 (a) assess how use of priority response origins indicated in the TDP will draw on the actual available resources (b) assess how current patterns of resource availability impact on performance (8-minute response for AS1 incidents) and (c) suggest possible changes in crewing and resource availability patterns across a week.

5.3.1 Resource Availability

The table below shows the current number of scheduled vehicles available for all workloads set out by hour for an average working week. This is derived from resource figures and crewing arrangement provided by the HSE North West Area Ambulance service.

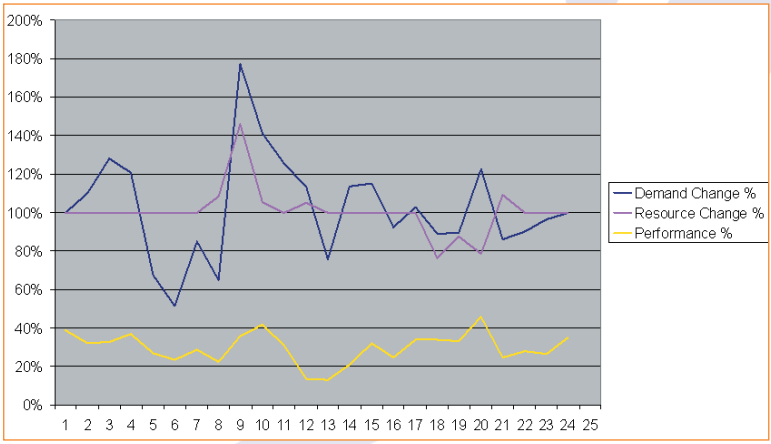
Table 5.1

Daily Resource Availability per hour																							
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	12	12	12	12	12	12	12	13	19	20	20	21	21	21	21	21	21	16	14	11	12	12	12	12
Mon	12	12	12	12	12	12	12	13	19	20	20	21	21	21	21	21	21	16	14	11	12	12	12	12
Tue	12	12	12	12	12	12	12	13	18	19	19	20	20	20	20	20	20	17	12	11	11	12	12	12
Wed	12	12	12	12	12	12	12	13	18	19	19	20	20	20	20	20	20	17	12	11	11	12	12	12
Thu	12	12	12	12	12	12	12	13	18	19	19	20	20	20	20	20	20	20	15	14	11	12	12	12
Fri	12	12	12	12	12	12	12	13	19	19	19	20	20	20	20	20	20	20	15	14	11	12	12	12
Sat	12	12	12	12	12	12	12	13	18	18	18	19	19	19	19	19	19	14	14	11	12	12	12	12

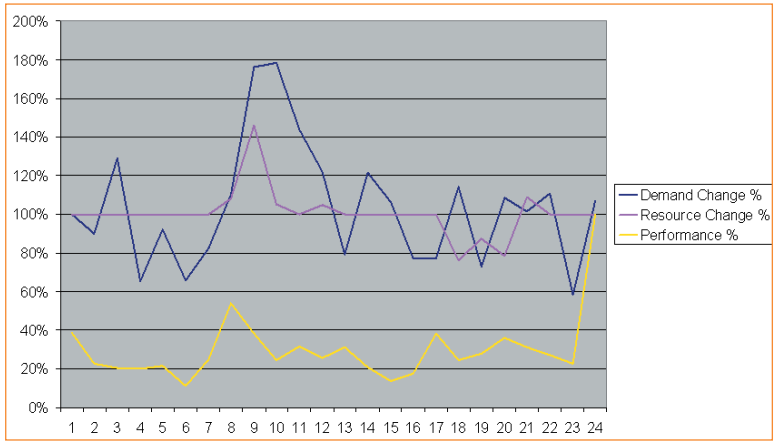
5.3.2 Work Load

The series of graphs below show how workload changes throughout the day, and compares this with both the percentage of resource change and the calculated emergency performance. Emergency performance is based on all AS1 incidents and the number of these that took 8 minutes or less from time of call to time at scene.

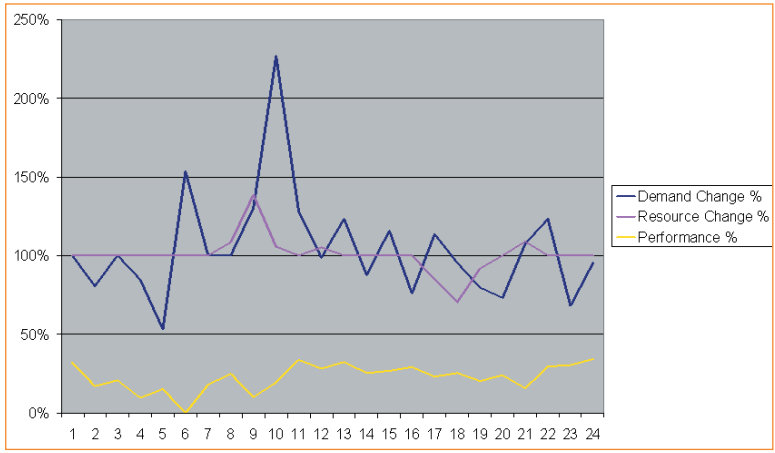
Sunday



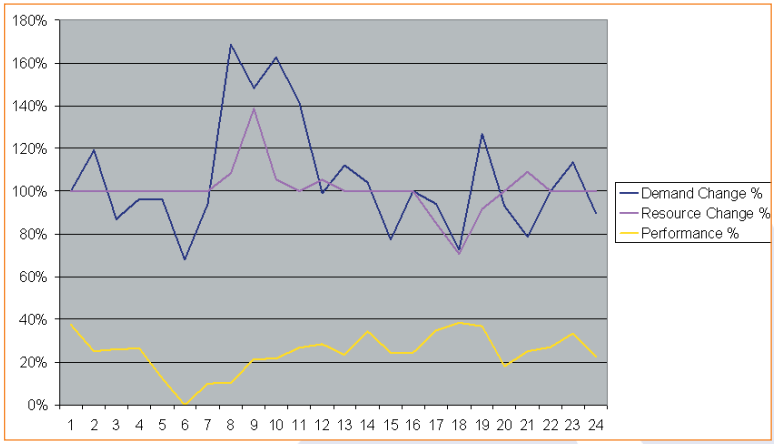
Monday



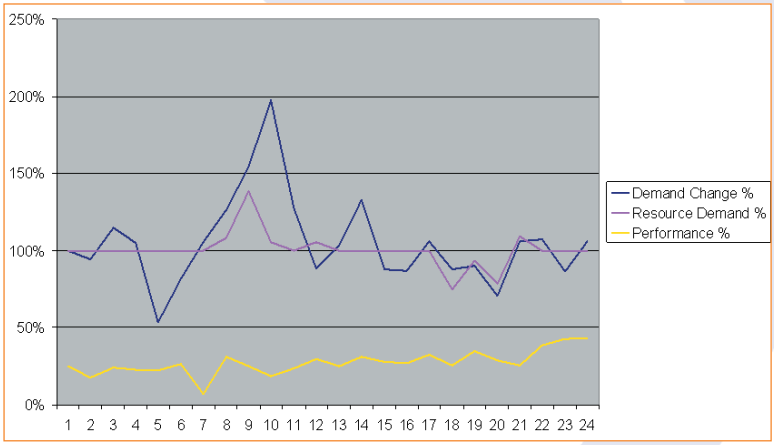
Monday



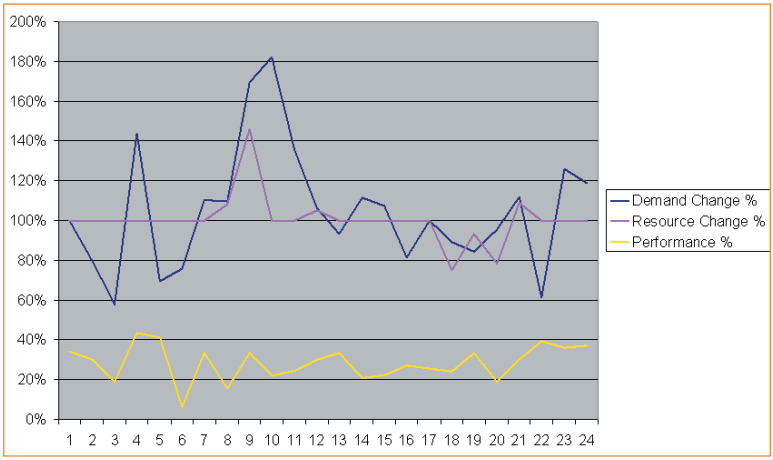
Wednesday



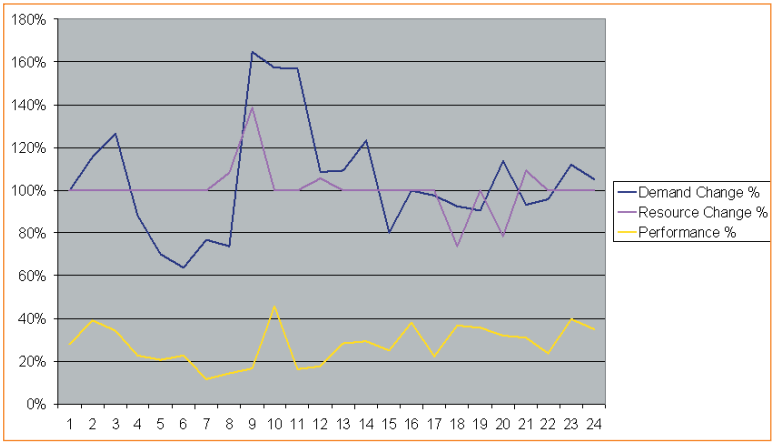
Thursday



Friday



Monday



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

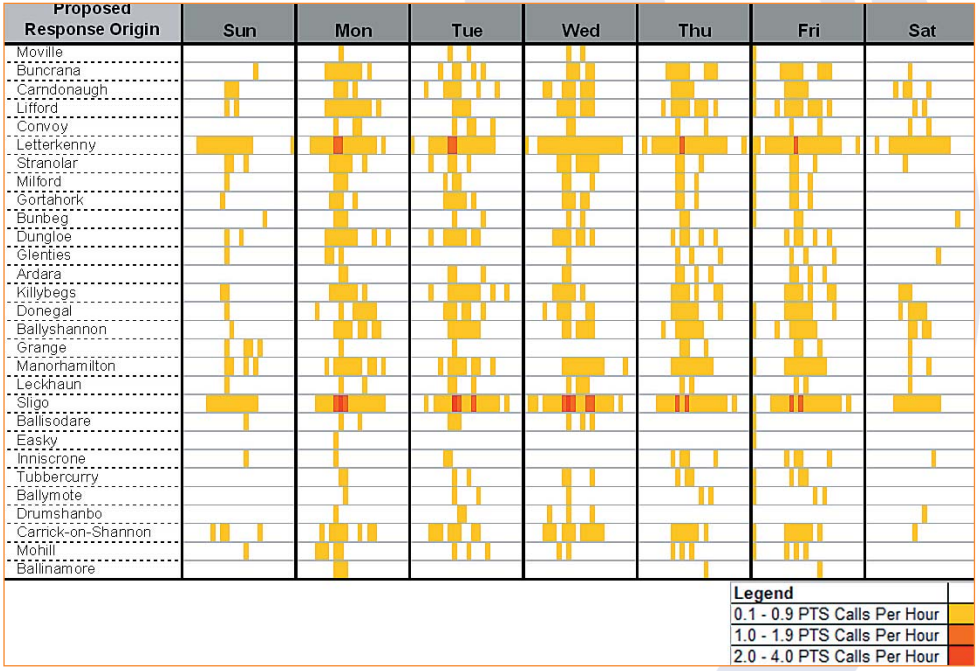
At the back end of each day (7-9pm) demand decreases, apart from Wednesday when demand increases. Resources stay constant throughout where they could potentially come off shift a little earlier in certain areas. In conclusion we find that current shift patterns are broadly in line with demand profiles except for the small changes identified in the mornings and evenings.

5.4 Impact of PTS Workload

This section aims to give an insight into the impact of using emergency resources for all patient transport work. The HSE NW Ambulance service is aware that the absence of an intermediate care or PTS fleet is draining the emergency resources available to the Ambulance service for emergency work. Using the PTS dataset the actual effects can be studied and quantified.

Figure 5.4 below shows for each response footprint, how many calls on average occur in each day and hour of the week.

Figure 5.4 Geographical and temporal spread of PTS workload



This shows that Sligo and Letterkenny have high PTS demand throughout the week. In some hours up to four PTS calls are been carried out in Sligo, which means four less ambulances are available for emergency work, probably for several hours after the time the PTS task commenced.

In earlier sections we noted patterns of PTS activity that reflected operational practice in Hospitals. While additional research is required to assess the degree that PTS activity may be undertaken the matrix in figure 5.4 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 Sligo and Letterkenny, because the demand is higher than anywhere else. Figure 5.5 is for Friday morning 09:00 hrs – 09:59 hrs. This shows that if the PTS demand is included, Sligo would get the first three vehicles available from the current fleet. The picture is very different if PTS data is excluded and the plan is based on emergency and urgent incidents only.

Figure 5.5 also shows how the number of vehicles available varies between the two plans. The yellow cells in the plan show how many vehicles should be available in this particular hour. Not only does the PTS workload drastically change the priorities of the posts, but the amount of time each job takes means that dispatchers are likely to have three less vehicles available to them.

Figure 5.5 Impact of PTS workload on the TDP

Including PTS Demand

HSE NW — Friday — 09:00:00 - 09:59:59 — 6

1	Sligo - A
2	Sligo - B
3	Sligo - C
4	Letterkenny - A
5	Letterkenny - B
6	Manorhamilton - A
7	Letterkenny - C
8	Ballyshannon - A
9	Killybegs - A
10	Carndonaugh - A
11	Buncrana - A
12	Carrick-on-Shannon - A
13	Lifford - A
14	Stranolar - A
15	Donegal - A
16	Leckhaun - A
17	Milford - A
18	Dungloe - A
19	Inniscrone - A
20	Glenties - A
21	Gortahork - A
22	Mohill - A
23	Ardara - A
24	Ballymote - A
25	Bunbeg - A
26	Convoy - A
27	Drumshanbo - A

Excluding PTS Demand

HSE NW — Friday — 09:00:00 - 09:59:59 — 9

1	Letterkenny - A
2	Sligo - A
3	Killybegs - A
4	Carndonaugh - A
5	Buncrana - A
6	Milford - A
7	Glenties - A
8	Inniscrone - A
9	Lifford - A
10	Ballymote - A
11	Ballyshannon - A
12	Carrick-on-Shannon - A
13	Convoy - A
14	Drumshanbo - A
15	Dungloe - A
16	Stranolar - A
17	Tubbercurry - A
18	Ballinamore - A
19	Bunbeg - A
20	Donegal - A
21	Gortahork - A
22	Leckhaun - A

5.5 Tactical Deployment Plan Impact Analysis

TDP's have been created for three different scenarios and a performance forecast has been calculated for each.

5.5.1 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. This was found to reflect operational conditions in the UK, no comparable Irish figures were available but nonetheless it is thought to reflect a reasonable level of abstraction.

5.5.2 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 acute care transportation. This means clear to clear times are reduced to an average of 80mins 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.

5.5.3 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, i.e. no abstraction, and the number of vehicles are not reduced due to vehicles off road, sickness, meal breaks etc.

5.5.4 Performance Forecasts

In the absence of any guidance as to current or future performance standards for the HSE NW Area Ambulance Service (see section 6), we have used the current UK standards as a parallel. Currently the UK is tasked with getting to 75% or more of all Cat A (life threatening) emergency calls within 8 minutes. To achieve this standard, Ambulance services need to be clear on what is and what is not a life threatening call and the need to be consistent in the calculation of start time. However, in forecasting performance, we have assumed the UK model exists.

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

In the absence of MPDS codes, AS1 incidents (Emergency) are assumed to be life threatening. This is quite a broad assumption and some (or perhaps many) AS1 incidents 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.

5.5.5 Summary

- Implementing the TDP should improve responsiveness to emergency demand by 8-10% points.
- If an intermediate care fleet was introduced to take care of all PTS work load, a further 10-12% point increase in the number of AS1 calls responded to in 8mins or less can be expected.
- Reducing the abstraction factor could move the Ambulance service on by another 6-8% points.

Table 5.2 Forecast performance improvement from TDP

% Performance 8 min AS1			
Current	Scenario 1	Scenario 2	Scenario 3
26-28%	35-37%	48-50%	56-58%

5.6 Impact of Additional Vehicles

For each scenario we have calculated the predicted impact on performance. This is based on which deployment posts would be covered in the TDP and the number of calls covered within 8 minutes from each. We have then assumed the next highest priority post is covered by the new vehicle.

5.6.1 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 A&E Emergency Ambulances 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 5.3 Marginal Impact of additional ambulance resource within TDP

Additional Impact of 1 Vehicle (A&E or ICV)			
Current	Scenario 1	Scenario 2	Scenario 3
0.00%	3.0-3.5%	2.5-3.0%	1.5-2.0%

5.7 Continuous Improvement

5.7.1 Current Situation

Currently there are issues with data quality that limit the analysis that can be carried out. Life threatening calls cannot be accurately extracted and analysed as the incident classification used is quite broad, and some of the incidents classified as ASI will not be life threatening. PTS information was collected using paper forms rather than electronic records, and the details collected were limited. Some assumptions had to be made around the time fields as reported elsewhere.

PTS work load impacts heavily on the number of Emergency Ambulances that are available to respond to emergencies. Whilst these vehicles remain responsible for PTS journeys, the emergency response potential is going to be suppressed.

From the evidence we were able to gain by asking questions in presentations, it seems that inter-agency working across the area can be improved. It is important to consider a range of initiatives to achieve sustainable improvements in Ambulance performance. In parallel with implementing the TDP, consideration should be given to driving down waiting times at hospitals, better relations with GP out of hours services, alternative intermediate care resources and designing and establishing Community Responder Schemes in rural areas.

5.7.2 Next Steps

The initial focus should be on data quality. Further data audits should be carried out at HSE level, and this should feed into a recommended data improvement program. This will then ensure that more robust analysis can be achieved in the future and performance can be calculated more accurately. Specifically, MPDS needs to be effectively rolled out in the despatching function and systems; the PTS module of the control systems needs to be proven and fully implemented, and data standards should be specified and training delivered to all concerned to ensure such standards are complied with routinely.

Alternative ways of responding to PTS work load should be investigated. Each alternative resource that is made available to do this work will maximise the emergency performance of the Emergency Ambulance fleet available, whilst sustaining the current PTS service.

Alternative emergency response should also be investigated and impact analysis carried out to suggest locations for Rapid Response Vehicles and Community Responder Schemes.

Verification of the TDP should be completed urgently (to include re-running all travel time analysis over a more appropriate road network dataset) and representative group of control, operational and union staff should be invited to fully understand the process, and to contribute to the configuration through a series of workshops. This is critical to the success of the TDP in an operational sense.

Design and execute a detailed plan to implement the TDP, probably in stages over a period of time. To ensure a close match between Ambulance emergency service demand and both the response footprints and the prioritising of response origins it is recommended that the TDP exercise be run every two to three years depending on demographic changes and changes in primary care and in hospital emergency care systems

6. DEMOGRAPHIC TRENDS AND SERVICE HIERARCHY IMPLICATIONS

In this section we discuss principal demographic and development trends in the North West and outline principal implications of these for the Ambulance services in the region, in particular on possible arrangements for a hierarchy of service delivery.

6.1 Demographic Trends

The CSO produced regional population projections to 2021 in May 2005 for the Border region which consists of counties Donegal, Sligo, Leitrim, Cavan Monaghan and Louth. By 2021 the region will have an estimated population of around 546,000 people. The CSO forecast that the majority of this increase will occur before 2011, with a 20% increase in population from 2002 to 2011, followed by a more moderate increase of 5% to 2021.

Table 6.1

CSO Population Projects (Border Region)			
Item		Border Region	State
Total Population		000's	000's
Year	2002	433	3,917
	2011	519	4,811
	2021	546	5,070

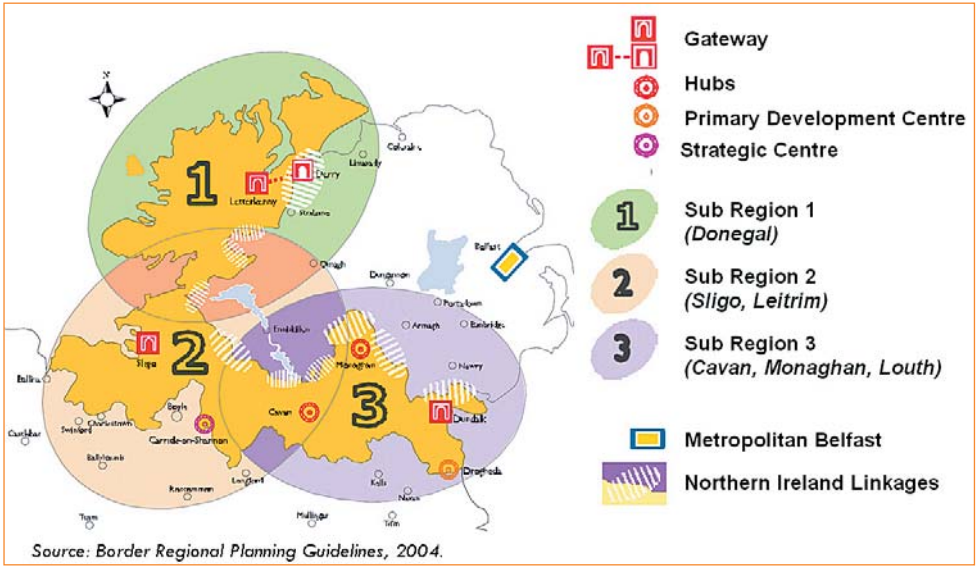
In addition to population growth the age structure of the population will have important implications for Emergency services. Initially up to 2011 the CSO foresee strong increases in the 25 to 64 age cohort and a reduction in younger cohorts. In the aged 65 plus cohort moderate increases to 2011 (13% increase from 2002 to 2011) will be significantly surpassed by strong growth in the numbers of older people with a 35% increase from 2011 to 2021.

Table 6.2

Age Structure Border Region (CSO Projections)						
	Age Cohort					
Year	Age 0 to 24	%	Age 25 to 64	%	Age 65+	%
2001	163	38%	208	49%	54	13%
2011	165	34%	259	53%	62	13%
2021	173	32%	288	53%	84	15%
% Increase	%		%		%	
2002 to 2011	1%		25%		15%	
2011 to 2021	5%		11%		35%	

Population growth will be strongly influenced by inward migration. The National Spatial Strategy, 2002, (NSS) identified a series of 'Gateways' and 'Hubs' which are designed to act as poles of development in their respective regions. In the HSE NW Area Sligo and Letterkenny were designated as Gateways. This designation will have important implications not only for their own population but also settlements surrounding them. The designations in the NSS dictate the future development patterns at lower levels of a planning hierarchy, in particular the Regional Planning Guidelines and respective county development plans. The Regional Planning Guidelines (RPG) broadly concurs with the population projections form the CSO and it divides the region into three units (see figure 6.1).

Figure 6.1 Sub-Regional divisions and general settlement strategy for the Border Region (Regional Planning Guidelines, Border Regional Assembly, May 2004)



The areas corresponding to the HSE NW Area are identified in sub-regions 1 & 2. The Border RPG suggests a total target population in 2020 of 249,000 persons (see table 6.3), representing a 12.4% increase from 2002. It is worth noting however that the 'high' population estimate from the RPG could increase the total in the HSE NW Area by as much as 20,000 persons, to 269,000 persons, or an increase of around 20%.

Regardless of the exact figure it is the location of increase in population and the future age structure that is of relevance to the Emergency services. The Border RPG has adopted a general settlement strategy that will promote sustained development in Sligo and Letterkenny, targets for these towns are that Sligo is set to increase in population from around 20,000 in 2002 to 40,000 by 2020 and Letterkenny from 15,000 to 35,000.

While these represent significant population increases for these towns there will also be increases associated with this increase in the neighbouring towns and villages. In rural areas, especially at some distance from the 'gateway' towns population levels are likely to remain static or may even decline. Planning policy that promotes development towns and villages is increasingly becoming prevalent and will limit population growth in rural areas. However in established areas of dispersed settlement such as along the west Donegal Coast from Killybegs to Fanad modest population is likely.

Table 6.3

Population Target (Border RPG)			
Sub Region	**2002** *000's*	**Target** 2020 *000's (+/10k)*	**Approx. % Increase**
Donegal (Sub 1)	137.6	145	5.4%
Sligo Leitrim (Sub 2)	84.0	104	23.8%
Total HSE NW (Est.)	**221.6**	**249**	**12.4%**
Sligo Town	19.7	40	102.7%
Letterkenny	15.2	35	129.8%

Source: Regional Planning Guidelines, Border Region 2004, CSO 2002

The CSO suggest that by around 2020 that 15% of the population of the Border region will be over 65. In the HSE NW Area this percentage is likely to be higher, especially in rural areas giving rise to contrasting populations in the main urban areas centred on Sligo and Letterkenny compared to more peripheral rural areas where an ageing population will be prevalent.

6.2 Infrastructure

The principal infrastructure trends for the region concerned are aligned to proposals in the NSS and the Border RPG, in essence they point to enhancements in the road infrastructure connecting along principal transport corridors. These will include:

National Primary Routes: (i) Castlebar - Sligo – Letterkenny [N15] onward to Derry (Western Corridor, Dual Carriageway), (ii) Sligo, Boyle, Carrick-on-Shannon and onwards to Dublin [N4] (some motorway sections), (iii) Sligo- Manorhamilton to Enniskillen [N16] and onward to Cavan [N3].

Secondary Routes: (i) Upgrading of the coastal route from Donegal town on to Killybegs, Dungloe to Falaragh [N56] (ii) Upgrading of Sligo to Ballina [N59], (iii) Upgrade Ballybofey Lifford Stranolar

Timeframes for these developments are not fixed, the National Roads Authority indicate that the Ballyshannon bypass will be completed in 2006 and by pass schemes in Rooskey will commence in 2006. Road schemes in Ballybofey – Lifford, Manorhamilton and Collooney are progressing through planning stages and are likely to be complete within around 3 to 5 years.

In the medium term to around 2015 much of the main schemes earmarked for the region in the NSS and Border RPG will likely be complete or near completion. There will be significant reductions in drive-times for the Ambulance services for destinations along the selected routes. For peripheral rural routes while on-going enhancements will occur, these will not have a major impact on reductions in drive-times for Ambulance services. Thus while there will be significant reductions in drive-times between major towns and to Dublin, accessibility of rural areas at distances from national primary and secondary routes will not dramatically alter from the current situation.

6.3 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 are will there be between 10% to 20% 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 increases 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 ageing of population, rural areas will have significantly higher proportions of older people than at present, and demand for services for older people will clearly increase. Furthermore, the project steering committee suggested that per capita call rates from rural areas may begin to increase as more people use emergency services in a similar way as urban populations.

Road improvements will improve accessibility between towns and villages connected by or close to national primary and secondary routes however no significant improvement in accessibility is envisaged for peripheral rural locations. Major population increases in the region will be located in the main towns and nearby villages, however a significant increase in demand for services for the elderly will be located in those rural areas where accessibility will remain weak. These are clearly areas where (a) Community Responder Schemes will enhance service provision, (b) better co-ordination of PTS and AS2 services will ensure more efficient use of resources and (c) ongoing Tactical Deployment Plans (TDP) will need to reflect the type of service demand arising from these peripheral areas.

6.4 Service Hierarchy

Given that use of TDP techniques in the region are at an early stage in their development the type of service hierarchy proposed here is intended to be indicative, to provide a basic framework for moving forward.

We have demonstrated that significant improvements in AS1 (emergency) response times are achievable through a combination of a new deployment configuration for current resources together with the development of intermediate care services to handle routine PTS services. The specific resource arrangements for intermediate care require additional research and indeed have implications for how outpatient services and other services within hospitals are organised and scheduled. Models in other jurisdictions include both scheduled services for multiple patients with 'routine' requirements and on-demand services that require specialised transport.

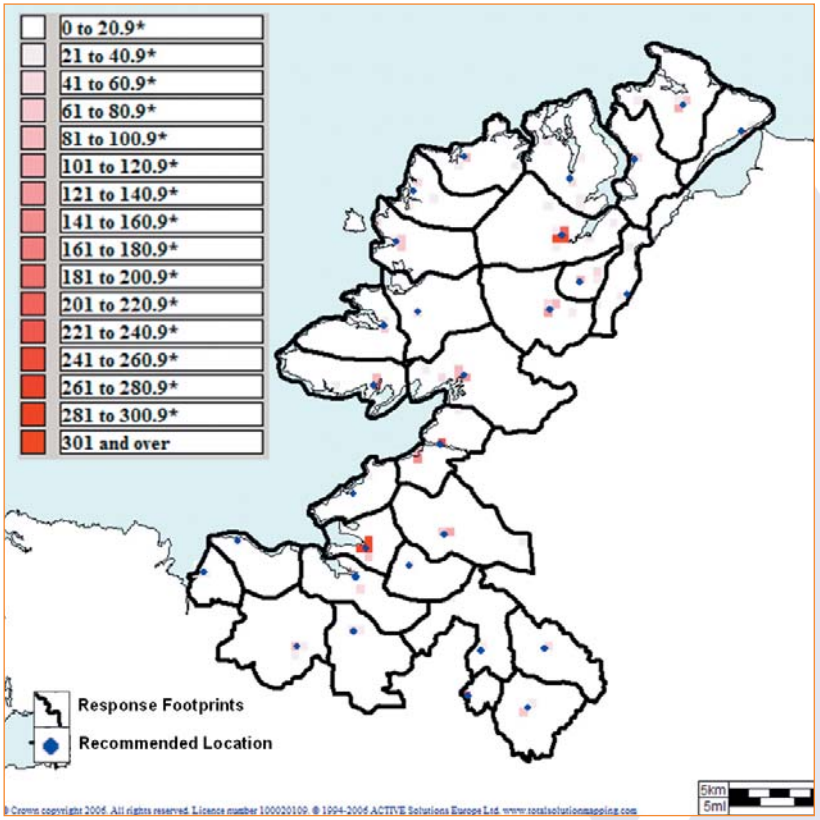
Ongoing developments within the HSE and PHECC indicate that advanced paramedic services will enhance the current standard EMT/Paramedic provision. At present the most likely location of Advanced Paramedic services will be based in Sligo and Letterkenny and will serve their respective extended catchments to cover the entire region.

Inter-regional services from other HSE Areas (West, North East and Midlands) have been demonstrated to potentially improve the Ambulance service response times . In this study it has only been possible to consider service demand from the NW Area alone. The development of a service hierarchy for the NW must however also include how services based outside the NW can be effectively used in the region, including potential for Ambulance based Advanced Paramedic services. And indeed the corollary of this applies where it will be necessary to configure service in the NW that will cater for emergency care demand from outside the region. Cross-border services with Northern Ireland also have important regional implications for service configuration. The relationship and type of service provision between Ambulance Station clusters in (a) Lifford –Stranolar – Castlederg (NIAS); and (b) Carrick-on-Shannon – Boyle; require evaluation to establish whether full Ambulance station provision is necessary within the context of a TDP that ensures availability.

Figure 6.2 below identifies the response footprints developed in the TDP and highlights areas where, lower emergency demand within isolated areas will benefit most from the development of Community Responder schemes. It is envisaged that these can be developed in parallel with on-going refinement and implementation of the tactical deployment plan. Four main areas are identified, Ardara, Gortahork – Falcarragh, West Sligo and South Leitrim, with a possible fifth in South East Donegal around the Northern Ireland Border. Rapid Response Vehicles are already deployed in Tubbercurry and Falcaragh and the development of Community Responder schemes in these areas will enhance and complement their services.

[5] Moore, D. National Spatial Analysis – Ambulance Service: compilation as related to road traffic accidents and population. Naas: Pre-Hospital Emergency Care Council, 2005. (Publication pending).

Figure 6.2 Indicative Regional Service Hierarchy



7. FINDINGS, CONCLUSIONS & RECOMMENDATIONS

7.1 Demand Analysis Findings

In total there were 10,648 AS1 & AS2 incidents during the study period from start of July 2004 to the end of June 2005 (7,524 AS1 incidents and 3,124 AS2 incidents). Demand levels for both AS1 and AS2 calls were broadly stable throughout the year although there were some small increases in demand for services in the summer months. Some of this increase was offset by higher proportions of hoax / aborted incidents.

During an average week a peak in AS1 calls was found to occur at weekends, while for AS2 calls higher levels of demand were found at the start of the working week (Monday) and the end of the Week (Friday). The differences between weekend and weekday (Mon. to Fri.) demand were reflected in the hourly levels of demand, where significantly higher numbers of AS1 incidents were recorded between 00.30 hrs and 3.30 hrs on weekends, in contrast during weekdays the peak in AS1 demand occurred around between 12.00 hrs and 14.00 hrs. AS2 activity occurred principally during the day, with highest demand around 13.00 hrs, at night, after 18.00 hrs demand for AS2 activity dropped strongly.

Figure 7.1

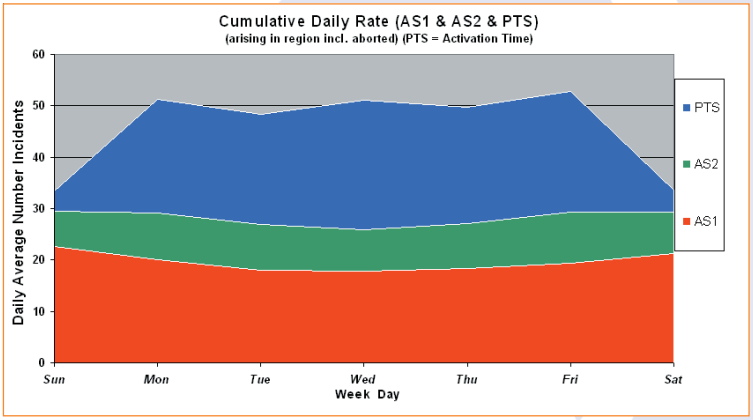
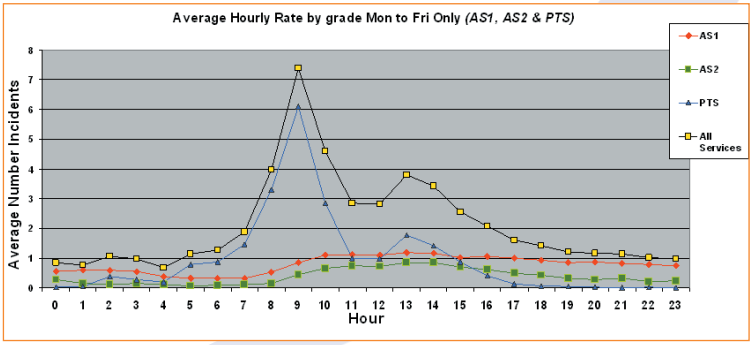


Figure 7.2



Note: PTS rates are based on estimated activation time, AS1 and AS2 on 'call creation' time.

In the study the region was broken down into a spatial typology consisting of the main towns (Sligo & Letterkenny); towns with a population greater than 1000 persons; rural areas with a population density greater than 10 persons per KM^2; and sparsely populated areas with a population density of less than or equal to 10 persons per KM^2. The highest demand levels for both AS1 and AS2 services were located in the main towns of Sligo and Letterkenny, with 16% and 10% of all AS1 and AS2 respectively. Per capita demand levels in these towns, and in other smaller towns was higher than in rural areas. In Sligo town there was on average 9.1 AS1 calls per 100 persons compared with 2.6 AS1 calls per 100 persons. Higher levels of demand for AS2 services were also found in urban areas.

Calls on 999 lines and from GPs make up the majority of the sources of all AS1 calls. For AS2 calls the principal call sources are from GPs, Hospitals and the Public line. On weekdays calls for AS2 from GP and Hospital sources increase strongly from 10.00 hrs to peak around 13.00 hrs with demand levels trailing off by the evening. Demand levels for AS1 services sourced from GPs also follows a similar diurnal pattern, although demand levels trail off less strongly during the early evening. At weekends as AS2 demand decreases calls for AS1 services increase and these are derived in the main from 999 sources.

Information on incident types was not found to be adequate to isolate 'life threatening' incidents from the AS1 records. This results in the possibility that Emergency work load, as identified by AS1 incidents, may be overestimated. Furthermore any particular spatial patterns concerning 'hot spots' of life threatening incidents clustering to particular locations may not be apparent in the data. This has ramifications on achievement of performance standards and production of the Tactical Deployment Plan (TDP) for the region, (see section 7.3 below)

In total 6,403 Ambulance based Patient Transport (PTS) incidents were recorded for the study period. Of these 5,290 involved PTS activity based in the NW Area only, 1,000 involved PTS activity to or from Dublin and 113 from other locations outside the NW. Demand by month for ambulance based PTS was relatively stable during the study period. November had the highest average number of PTS incidents per day at 21 incidents and April the lowest with 15.6 incidents per day. On a weekly basis the majority of PTS activity occurred from Monday to Friday, with on average from 23 to 25 occurring each weekday. At weekends numbers of PTS incidents dropped to less than 5 per day on Saturdays and Sundays. Appointment times for PTS patients were used to estimate Ambulance mobilisation times and these indicated that Ambulance based PTS services had a strong demand peak for resources around 09.00 hrs. Smaller demand peaks for ambulance resources were apparent around 03.00 hrs (for Dublin services) and later in the day around 13.00 hrs (see figure 7.2).

The majority of PTS services were provided from Sligo station (39.6%) and Letterkenny station (21.1%). Spatial clustering of activity for picking-up patients was apparent around other stations however the majority of destinations were centred on Sligo and Letterkenny. Trip distances were calculated using straight-line distances from Ambulance station to respective pick-up locations and onward to destinations, these showed that Ambulances based at Killybegs had the highest average trip distances at 80.1 Km per trip. Ambulances based in Sligo and Letterkenny had the lowest average trip distances with 10.0 and 24.7 km. respectively (excluding Dublin trips). Long distances trips to Dublin (1,000 in total) had an average travel distance of 264 Km, (station to pick up to destination).

Demand for all Ambulance based services is higher during weekdays and also displays distinct peaks in demand in the morning and again around lunchtime (see figures 7.1 and 7.2 above). There are opportunities to manage these activity levels through a variety of interventions. These include dialogue with GPs and Hospitals with an aim to re-configure schedules for PTS activity and aspects of AS2 activity. While such interventions are beyond the scope of this study, it is apparent that extending the PTS peak activity from 09.00 hrs in the morning through

altering appointment times and to include weekend PTS activity will smooth out peak demand for these services. In respect to AS2 activity additional research is required into the nature of demand for services that occurs on weekdays around 13.00 hrs, opportunities may exist to better manage this demand activity in an attempt to extend demand later into the afternoons.

To assist in the availability of emergency resources, intermediate care vehicles and minibus services will provide a better utilisation of resources, through allowing multiple occupancy vehicles and better scheduling of services for some patients, particularly ambulatory patients requiring out-patient hospital services. Again such interventions extend into other aspects of patient care management in the hospitals. Information on patient needs and patient type is poorly recorded on AS3 forms (PTS Records) and without good information; it is difficult to be definitive on the precise patients needs.

In addition to information needs on patient types an additional weakness in the current systems of data capture involves lack on data on the location of resources when they are assigned for either AS1, AS2 or PTS activity (this and other aspects of data capture are examined in appendix 1 of this report).

In conclusion the temporal and spatial analysis of demand highlights how demand varies with location and when demand peaks of services occur. This provides information on quantum of emergency care activity in the region and a baseline that can be used to measure the impact of interventions and changes in the spatial configuration of Ambulance service resources in the future.

7.2 Performance Findings

The performance analysis examined response times for Ambulance services for both AS1 and AS2 activity. Response times were defined as the time of call receipt[6], (clock start) to the time of the first resource to the incident scene (clock stop). The average response time for the study period for the entire NW Area was 18.1 minutes for AS1 & AS2 incidents combined, with 15.5 minutes for AS1 incidents and 26.0 minutes for AS2 incidents alone.

For the NW Area 27% of all AS1 incidents had a response time of less than 8 minutes, however there were significant differences between the urban locations of Sligo and Letterkenny where 60% and 54% respectively of AS1 incidents were responded to in less than 8 minutes.

Table 7.1

Response time *Summary (Percentage Incidents)*			
NW Area	Emergency (AS1)	Urgent (AS2)	All Incidents
<= 8 Minutes	27%	15%	24%
<= 14 Minutes	46%	28%	40%
<=25 Minutes	73%	48%	65%
Sligo Town (<= 8 Minutes)	60%	30%	52%
Letterkenny (<= 8 Minutes)	54%	26%	46%
Rural Areas (<= 8 Minutes)	11%	7%	10%

Difficulties in isolating solely 'life threatening' incidents from the AS1 calls and differences in settlement structures of the NW restrict direct comparisons with performance attainment in other jurisdictions. To draw conclusions concerning performance attainment and potential patient outcomes information on patient condition is required. This is an urgent recommendation from this study.

[6] Taken to be the time when the caller has been identified, the nature of the incident and the .... location of the incident have been ascertained.

7.3 Tactical Deployment Plan Findings

A Tactical Deployment Plan (TDP) for the region was developed which identified 'response footprints' in the region and a series of 'response origins' that would address AS1 and AS2 incidents within the region. These were devised from the demand profile for different areas throughout the region. When used with available resources modelled over 168 hours of a week, these provide optimum locations for best use of resources. In total 29 'response origins' were identified and the software based TDP viewer provided as part of the deliverables of the study suggest where resources should be ideally placed to respond most effectively to AS1 calls for the region. All current ambulance stations (11 stations) were confirmed as 'response origins', together with the current RRV locations (2 locations). The remaining 16 response origin locations provide comprehensive spatial cover for the region. An important feature of TDP is that data capture systems in the Ambulance service in the region need to be capable of separating 'life threatening' calls to fully assess emergency demand.

The 'response origins' were assessed against three scenarios to demonstrate how use of the TDP could improve overall performance. These involved; (i) use of current resources with no change in PTS activity (including an abstraction factor to allow for vehicles off road and staff sickness etc.); (ii) current resources but where PTS activity is undertaken by a separate and dedicated PTS fleet (including the same abstraction factor), and (iii) where a dedicated PTS fleet is utilised but with no abstraction factor. The results of the analysis demonstrated potential changes in a presumed 8-minute response time target for the region, by forecasting the additional percentage AS1 incidents that could be responded to in that time.

Table 7.2 Forecast performance improvement from TDP on 8-minute emergency response (AS1)

% Performance 8 min AS1			
Current	Scenario 1	Scenario 2	Scenario 3
26-28%	35-37%	48-50%	56-58%

The resource availability is a key factor in the TDP analysis and current resource availability (crewing times) were examined against demand. These indicated that current availability is broadly in line with demand patterns and that with minor adjustments in crewing in the morning and evening shifts a very close match can be achieved.

An additional element of modelling was also undertaken for each of the above scenarios which assessed the impact on performance for each scenario where an additional new vehicle is included. This demonstrated a marginal improvement for scenario '1' of between 3.0% to 3.5% improvement on performance achievement for an 8-minuate target for AS1 incidents. For the other scenarios the percentage improvement was less (see table 7.3)

Table 7.3 Marginal Impact of additional Ambulance resource within TDP

Additional Impact of 1 Vehicle (A&E or ICV)			
Current	Scenario 1	Scenario 2	Scenario 3
0.00%	3.0-3.5%	2.5-3.0%	1.5-2.0%

7.4 Demographic Trends and Service Hierarchy

Increases in future demand for emergency services will arise firstly from population growth in the region and secondly from the location of that population growth. Very strong population growth is forecast for both Sligo and Letterkenny, and more moderate increases will occur in towns close to these growth centres. These rates of population growth are supported by the National Spatial Strategy and the Border Regional Planning Guidelines. It was demonstrated higher per-capita demand occurs in urban areas compared to rural areas and therefore the location of population growth will have a type of 'multiplier' effect on demand for emergency services.

In tandem with urban growth, rural areas will be characterised by an increasingly older population, which in turn will put additional demand for emergency services.

Infrastructure improvements on national routes will continue to shorten drive times between major population centres. In rural areas at some distance from these routes drive-times will remain close to current times. Use of the TDP helps overcome this as it ensures resources are located as close as possible to where demand arises. To further assist in providing enhanced services in isolated areas a number of priority areas are identified for the development of Community Responders in parallel with on-going development of Tactical Deployment Plans.

Given the rapid changes in population, infrastructure and continuing developments in primary care and pre-hospital emergency care the case for on-going analysis of demand for emergency services is strong, ideally capacity for such analysis should be developed within the respective Ambulance Service itself.

7.5 Conclusions & Recommendations

This study is, to the authors' knowledge, the first of its kind undertaken on 'real-time' Ambulance records from an Ambulance Service in the Republic of Ireland. As such the study has expended considerable effort on data validation and reporting of data issues to examine how we can use Ambulance records to enhance future service delivery. Thus the report firstly addresses a research agenda on the utility and quality of Ambulance records. We have demonstrated that accurate and comprehensive data capture has inherent value in producing evidence based analysis of the spatial and temporal profile of emergency service demand and performance and also where this analysis can be used to improve service provision. Many of the findings on data quality have relevance to other HSE Areas, as the report highlights certain minimum data standards and content required to indicate where improvement in service delivery can be made. Also of note in this regard is what data are required to allow comparison between different regions. An easily applied spatial typology has been put forward to facilitate this.

Secondly, 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 HSE North West Area. The TDP demonstrates how use of additional deployment points used in conjunction with operator knowledge can make significant improvements on performance in the region. The analysis also demonstrates how use of emergency Ambulance resources in Patient Transport Services impacts on responsiveness to emergency incidents in the region. In the course of the project preliminary findings were presented to Ambulance staff in the HSE NW Area, the next steps for implementation and 'roll-out' of the TDP envisages continued consultation with staff to ensure operational relevancy of the 'response-origins' , respective crewing requirements and support for exact locations of deployment points.

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

In tandem with the TDP we identify a number of priority locations where Community Responder Schemes should be initiated. It is envisaged that these will provide enhanced emergency service provision to isolated rural areas.

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 HSE areas, but also progress the potential enhancements in the Ambulance Service for HSE NW Area.

R1) Transfer methods of analysis to other HSE Areas:

The findings in this study and the methods adopted provide a baseline for analysis of emergency service demand for other HSE Areas. Extension of the analysis to other HSE areas 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 on-going changes in health care 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) Undertake Data Audits:

In advance of undertaking additional analysis in other HSE areas data audits of the content, format, consistency and spatio/temporal accuracy of Ambulance records is required. Automatic digital capture of Ambulance records is a pre-requisite to undertaking the analysis and in the production of Tactical Deployment Plans. Even where records are captured digitally, variability in data protocols and management practices are likely to produce data sets of variable utility. Certain minimum data levels are necessary to undertake the type of analysis envisaged and ensure that comparisons between HSE areas are possible.

R3) Future Data Capture and Patient information:

A number of specific recommendations are listed in the separate technical report on Data Capture. A pressing issue arsing from this 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. This imperative also extends to information on patient needs for Patient Transport Services.

Other additional data items that will enhance demand and performance analysis together with the production of TDP's are additional information on the location of Ambulances when they are assigned to an incident, and explicit data on when and where an Ambulance is when 'stood-down'.

A further key finding from the technical report on data capture is the need to develop 'in-house' skills in data management and analysis. Ultimately responsibility for analysis of demand, audits of performance and evidence based interventions (such as the TDP) should be carried out by Ambulance staff themselves.

R4) TDP Implementation Support:

The TDP developed in this study has demonstrable benefits for enhanced responsiveness to emergency incidents in the HSE NW Area. 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 of response origins') there are significant changes in operational practice within the Ambulance Service that require management guidance. On-going support from all agencies concerned is required to ensure its successful implementation.

R5) Inter-regional methodology:

On going 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 NW Area, these are;

R6) Revision of TDP:

Given the rapid population growth, on-going urban growth and changes in infrastructure a revised and updated TDP exercise is required for the NW Area in the near future. The data capture and transfer issues that have been resolved and digital capture of PTS records in the NW Area that has been put in place, means an exercise to revise the TDP of the region does not represent a significant task and can be undertaken in a relatively short time.

R7) 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-by 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 with the TDP.

On going 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.

R8) Patient Transport Service & Inter-agency consultation:

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

Appendix 1. Data Capture (Technical Report)

Technical Report
on Data Capture and Quality Issues Concerning
Ambulance Records in the HSE North West Area

1. Background:

This report is associated with the Spatial Analysis of Ambulance records from the North West Area being undertaken on behalf of the Pre-Hospital Emergency Care Council and the Ambulance Service of the HSE North West Area, by Spatial Planning Solutions Ltd., and Active Solutions, UK Ltd.

Many of the issues examined in this report were discovered in the course of the project and brought to the attention of the project sponsors by Spatial Planning Solutions and Active Solutions.

The report has been put together by David Moore, of Spatial Planning Solutions, Ltd. and Tony Cummins, Ambulance Communications Officer, HSE NW Area.

The report outlines issues that have arisen concerning data quality issues in respect to Emergency (AS1), Urgent (AS2) and Patient Transport services (PTS) records for the study period of the project.

2. AS1 and AS2 data:

Data for these records were entirely generated in the FORTEK control system utilised by the control room of the Ambulance service. As an entirely digital process records from this source may be considered to accurately reflect the activities of the Ambulance Service, however a number of issues arose. Data for AS1 and AS2 for the study period was provided in September 2005 and examined over the following weeks. This was presented at the meeting in Belfast on December 15th, 2005. A number of data problems were highlighted, including over 2,500 records with negative Mobilisation time, records with overly long Mobilisation times, records with no on-scene times, records where Incidents had no corresponding Resource information, and a number of records that had no 'left-scene' time, 'hospital' time, and 'available' time. Over the Christmas period many of these issues were resolved where records were either corrected by control staff in the NW Area or technical solutions found to overcome inconsistencies. The problems that occurred can be broken down into system problems and input / operator problems.

In addition to capture management issues, there are broader data issues relating to incident type, and patient type which are discussed below

2.1 System problems:

There are three principal system problems that affected data quality; (1) incorrect capture of time stamps due to unsynchronised clocks between different computers attached to the system; (2) inability of the system to explicitly record when an individual Ambulance is 'stood down' from an incident. (3) forcing of the amended / corrected records to use 'current date' (i.e. date of correction).

The system clock issues resulted in the negative time stamps found in many records as 'creation time' captured on one computer being significantly different to the system clock on the main server controlling time stamps for other events. All records where this occurred were identified and a corrected 'creation time' was updated to the records used in the study.

The exact location of where Ambulance resources are when they are assigned is not included in the system. The assumption is that an Ambulance is located at its base station. In the majority of cases resources are indeed assigned from base, however at times the resources may be located while in 'clear & available' status away from base. To account for efficiency in service delivery this issue must be addressed.

The lack of explicit identification of Ambulances that were assigned to an incident but subsequently withdrawn results in apparent gaps in the records. While the 'return time' is always captured for these resources there are absences in other time stamps when the database is queried for by the individual incident. Most of the records that had no 'on-scene' time were in fact such instances; however there is no explicit reference to this. Thus while there is a code to identify where an incident is 'stood down' there is no reference in the system where an Ambulance in a multi-resourced incident is re-assigned or sent back to base. A routine was developed that explicitly identified these records to allow subsequent analysis.

Date forcing has a small number of records, where the date of correction has been imposed instead of the date and time of the resource records. Where possible these have been corrected resulting in less than 5 such records.

2.2 Input and Operator problems:

Initially it appeared that a very high number of data errors were related to operator errors or omissions. While there remains a good deal of issues that need to be examined the principal aspects of the project are concerned with incident locations and time stamps firstly up to 'on-scene' time and then to 'return-time' as these indicate the resource availability and will influence deployment points.

Operator error was identified by Spatial Planning Solutions and addressed in three phases of error identification and correction. Most concerned absence of time stamps or incident locations. An excel sheet was put together that listed the errors associated with each operator and they then corrected their own errors. In total about 500 records needed attention.

There were many records where operators failed to include 'left-scene' time, at 'hospital time', furthermore there appears to be an inconsistency between 'clear', 'clear and available' and 'return to base'. All records included a 'return time' but few of the other time stamps were included, this is adequate in this study as it indicates the length of time a resource is un-available. Other studies where time spent 'on scene' and in the hospital is important may require a more consistent recording pattern or protocol. From the records available we can establish general patterns however.

All operator input issues have been addressed by management and staff in the Ambulance service of the NW Area.

3. Incident Type:

The Steering Committee of the project indicated that information on incident type for all records lacked suitable clinical context and robustness. The codes used in the FORTEK system do not correspond to the MPDS patient record systems being developed by the PHECC. This renders information of incident type currently being collected to be of little analytical value.

This feature of the data used in the study is relevant to not only the HSE NW Area but to all HSE Ambulance Services. Without consistent recording of agreed standards on incident types in particular in relation to 'life threatening' incidents, the benefits of in depth analysis on Ambulance Service performance is limited.

4. Patient Transport Services (PTS)

All patient transport service records were input from paper records covering the period and there was no automated input. Significant issues arose from this concerning the time stamps of individual events and consistency of the addresses of pickup and destination locations. A modelling exercise was put in place that firstly made addresses consistent, then estimated travel times between Ambulance stations to pickup locations, onward to destinations and back to Ambulance stations. Time stamps were then allocated on the basis of the travel times centred on the consistently entered 'destination time' (the appointment time of the patient).

As stated above in respect to AS1 & AS2 data, the exact location of where an Ambulance resource is located when assigned needs to be included in the data capture protocols.

Information on Patient type, in particular on patient mobility is not clearly defined at present and there may be inconsistencies in recording this data at present. Consideration into questions of why patients require transport services may assist in providing more focused services and which better reflect patient needs.

Automatic digital capture of PTS records has begun in the HSE NW Area with the PTS activity being recorded within the Ambulance Service's FORTEK system. This will overcome the problems faced within this study, provided consistent records are maintained. In order to ensure that the full commitment to PTS activity is recorded all taxi and minibus PTS activity should be recorded with the same rigour.

5. Conclusion & Recommendations:

Many data quality items have arisen during the course of this study which were difficult to predict at the outset. The best way to evaluate data quality is to actually start asking operationally relevant questions of it. Inconsistencies / anomalies related to data capture techniques can thereby quickly become apparent. Much effort has been put into ensuring the data used in the study is suitable for the purpose. In the future a 'cradle-to-grave' approach should be in place in terms of treating individual data items. The absence of data, or use of blank fields, is not an appropriate method of dealing with a resource event, as occurs for example when a resource is stood down in a multiple resources incident, an explicit code for such events should always be used.

While data recommendations was not part of the original brief we provide below a series of recommendations for future work in this field;

1) Careful system analysis is required on installation and commissioning of computer control technology, the unsynchronised clocks is indicative of the absence of such a comprehensive examination of the FORTEK system.

2) All changes in Ambulance status should be made explicit, 'blank' items, in particular when a resource is 'stood down' should not be used. When an Ambulance is stood down, for whatever reason a time stamp and position should also be allocated to the incident record.

3) Clarification of the role of and completion of time stamps after a resource arrives on scene is required. Many data items are missing and there is an inconsistency between 'clear' time, 'clear and available' and return times.

4) Inclusion of additional geographic stamps would be useful in future resource analysis. In particular the location of where Ambulances are when they are assigned, when taken off an incident, and when 'clear' / 'clear and available'.

5) The Ambulance service in the HSE NW Area had no way of examining data and assessing data quality, the system as it stands must be queried from the UK and then data sent on to third parties for evaluation. More system knowledge and expertise based locally would help overcome this.

6) PTS data collection should include all PTS activity, including taxi and minibus activity, where appropriate better data definition on patient mobility is required, and consideration should be made on determining the type of hospital services used by patients as this can inform us on how different patients use transport services.

7) MPDS should be rolled out as a matter of urgency to ensure better understanding of incident type and account for 'life threatening' incidents.

Appendix 2 Response Origins

The Tactical Deployment Plan provides a guide for Control Room staff to match location of demand for services to suggested deployment points (Response Origins). The hours listed provide an indicative measure of average manning hours. The reader is referred to the Tactical Deployment viewer (delivered to NW Area) to get a full picture of deployment options.

Proposed Response Origin	Existing Response Origin Activity	Average Weekly Manning Hours [1]
Sligo [2]	Station	168
Letterkenny [2]	Station	168
Donegal	Station	158
Ballyshannon	Station	155
Carndonaugh	Station	150
Killybegs	Station	146
Carrick-on-Shannon	Station	145
Stranolar	Station	142
Lifford	Station	138
Manorhamilton	Station	138
Dungloe	Station	134
Gortahork	RRV *(Falcaragh)*	136
Tubbercurry	RRV *(Alternate Weeks)*	108
Buncrana	No	146
Bunbeg	No	136
Milford	No	135
Mohill	No	121
Ballisodare	No	120
Moville	No	117
Ballymote	No	100
Ardara	No	109
Convoy	No	107
Drumshanbo	No	89
Glenties	No	89
Grange	No	74
Leckhaun	No	73
Inniscrone	No	69
Ballinamore	No	62
Easky	No	55

Notes:

[1] *Average Weekly manning hours is an indicative figure that reflects demand for services within the 'response origin' footprint.*

[2] *Sligo and Letterkenny have Double and Triple manning times during a week to reflect demand*

Appendix 3 Cross Tabulation – Incident Types with Patient Type by Pick-up Location

Cross Tabulation	Pick Locations with Incident Types and Patient Type					
Pick Location	***Incident Type***	**Ambulatory**	**Stretcher**	**Wheelchair**	**Not Listed**	**Grand Total**
Sligo Town	Admission	1	86		13	100
	Day Clinic	174	948	57	90	1,269
	Discharge	19	47	2	7	75
	Return	5	25	4	3	37
	Transfer	62	1,036	19	71	1,188
	Total	***261***	***2,142***	***82***	***184***	***2,669***
Leterkenny Town	Admission		72	1	12	85
	Day Clinic	16	677		46	739
	Discharge	17	52		5	74
	Return		14		1	15
	Transfer	21	1,040		71	1,132
	Total	***54***	***1,855***	***1***	***135***	***2,045***
Main Towns (population over 1,000)	Admission		33		9	42
	Day Clinic	6	314	1	23	344
	Discharge	3	24		2	29
	Return		1			1
	Transfer	4	90		14	108
	Total	***13***	***462***	***1***	***48***	***524***
Rural Areas (Higher Density)	Admission	1	97		8	106
	Day Clinic	10	387	2	30	429
	Discharge	6	26		2	34
	Return		1			1
	Transfer	3	168		19	190
	Total	***20***	***679***	***2***	***59***	***760***
Rural Areas (Lower Density)	Admission		21			21
	Day Clinic	1	16		2	19
	Transfer		12		3	15
	Total	***1***	***49***		***5***	***55***
Dublin	Day Clinic	2		15		17
	Discharge	1		8		9
	Return	8		42		50
	Transfer	30	3	191	1	225
	Total	***41***	***3***	***256***	***1***	***301***
Galway	Return			1		1
	Transfer	1		13		14
	Total	***1***		***14***		***15***
Northern Ireland	Admission	1		2		3
	Day Clinic			2		2
	Discharge			1		1
	Return			2		2
	Transfer	4	1	21		26
	Total	***5***	***1***	***28***		***34***
Grand Total		***396***	***5,191***	***384***	***432***	***6,403***

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