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

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

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Pre-Hospital
Emergency Care
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1. Introduction and Background

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

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

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

Project Aims

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

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

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

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

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

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

Team Approach

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

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

Study Period and Data Collection

Data for the study was supplied by the ambulance service of the Southern region and covers the period 1st January 2007 to 31st December 2007. This period was considered appropriate to allow a suitable overview of demand for ambulance services to generate the first generation of Tactical Deployment Plan for the region.

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

As the data from County Kerry is not in digital format it does not form part of the analysis of tactical deployment in the Southern region.

Report Structure

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

Acknowledgements

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

2. Emergency & Urgent Incident Demand Analysis

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

2.1 AS1 & AS2 Capture & Data Description

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

Table 2.1

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

Incident Location;

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

Incident Numbers;
The total number of AS1 and AS2 calls recorded was 21,316. A number of incidents were 'stood down' either before or after resources were assigned or sometimes after a resource had reached the location of an incident. In general all incidents where the ambulance(s) have reached the scene are considered in all aspects of the study and are identified in table 2.2 as 'unique responded incidents with location'; there were 13,922 AS1 and 5,975 AS2 such incidents in the Southern region in 2006 (see table 2.2).

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

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

Table 2.2

Total Incident in HSE South West Region				
Incident Type	**AS1**	**AS2**	**AS3**	**Total**
Unique Responded Incidents with Location	13,922	5,975	7,990	27,887
'Stood Down' before 'At Scene Time'	827	58	81	966
'Stood Down' unspecified Location	14	-	-	14
No 'At Scene' time	384	132	110	626
Unspecified Location	3	1	7	11
Number of Incidents	**15,150**	**6,166**	**8,188**	**29,504**

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

2.2 Temporal Variability

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

2.2.1 Monthly Variation

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

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

Table 2.3

Average Monthly Variati on (All incidents)						
Month	**AS1**	**AS2**	**Total AS1 & AS2**	**Per Day**		
				AS1	**AS2**	**Total**
January	1,218	580	1,798	39	19	58
February	1,097	572	1,669	39	20	60
March	1,218	561	1,779	39	18	57
April	1,202	497	1,699	40	17	57
May	1,256	536	1,792	41	17	58
June	1,306	489	1,795	44	16	60
July	1,273	523	1,796	41	17	58
August	1,312	482	1,794	42	16	58
September	1,260	491	1,751	42	16	58
October	1,316	502	1,818	42	16	59
November	1,255	471	1,726	42	16	58
December	1,437	462	1,899	46	15	61
Total	**15,150**	**6,166**	**21,316**	**42**	**17**	**58**
Average Monthly	***1,263***	***514***	***1,776***			

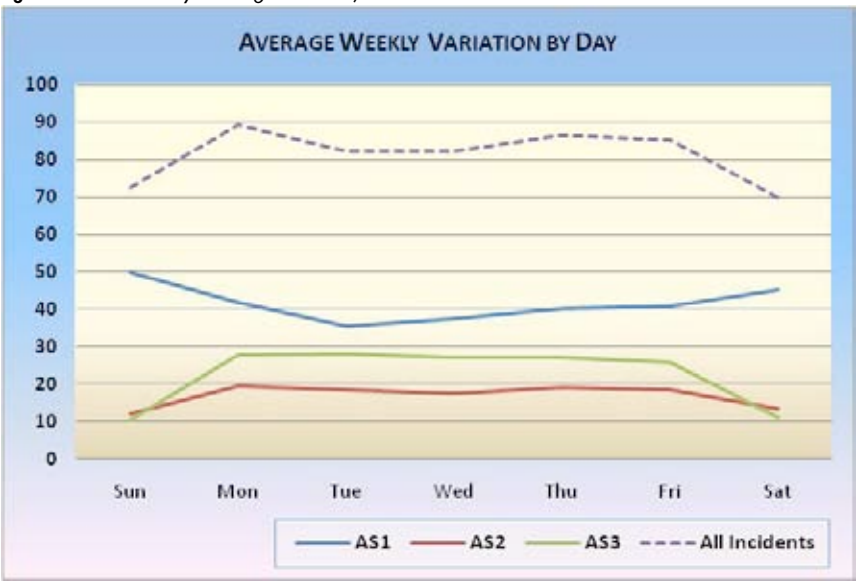
Within the region the average monthly rate for AS1 incidents was 1,263 and 514 for AS2 incidents. December had the highest numbers of incidents of any individual month; December also has the highest daily average of any month for AS1 calls with a daily average of 46. This is higher than the annual daily average of 42 AS1 calls per day, although not as significant as other regions. Within the December figures, highest rates of AS1 calls occurred over the Christmas period which began in 2006 around Saturday the 22nd of December.

2.2.2 Weekly Variation

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

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

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



2.2.3 Daily Variation

When taken together across all days of the week the average hourly rate of AS1 incidents in the Southern region is relatively stable at generally around 1.7 incidents per hour, the exception to this in the very early morning between 04.00hrs and 07.00hrs when demand reduces to below one incident per two hours. In contrast AS3 demand is almost exclusively only required during the day. Call rates for AS3 show a marked drop between 12.00hrs and 14.00hrs (lunchtime) and pick up again until 16.00hrs after which rates begin to reduce rapidly. AS2 demand is also concentrated during the day, however there is no apparent demand reduction over lunchtimes, and the evening reduction is significantly less marked than that of AS3 calls (see figure 2.2 below).

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

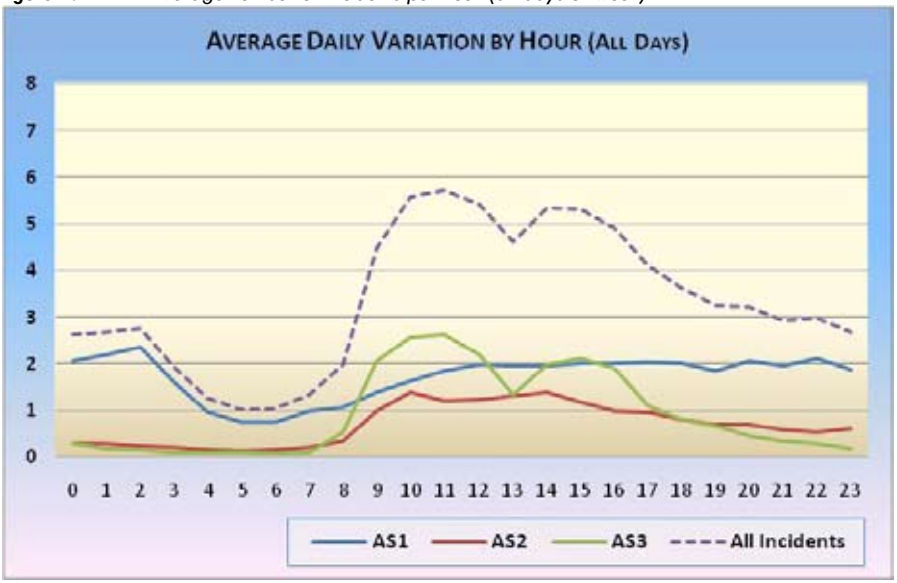


Table 2.4

Average Daily Variation by Hour (All Days)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***1.7***	***0.7***	***0.9***	***3.4***
Ave. 08.00 to 18.00	*1.8*	*1.1*	*1.8*	*4.6*
Ave. 19.00 to 07.00	*1.7*	*0.4*	*0.2*	*2.3*

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

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

Figure 2.3 *Average number of incidents per hour (Weekend Only)*

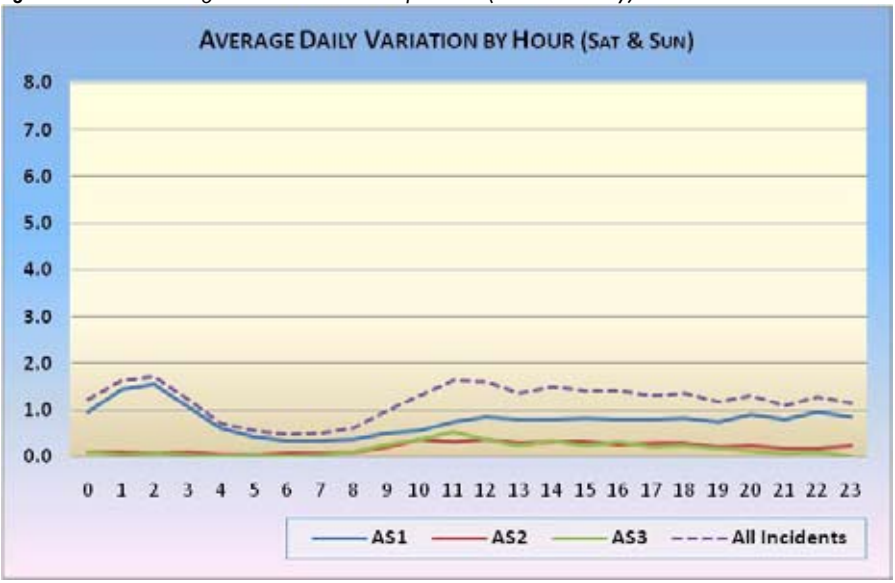


Table 2.5

Average Daily Variation by Hour (Sat & Sun)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***0.8***	***0.2***	***0.2***	***1.2***
Ave. 08.00 to 18.00	*0.7*	*0.3*	*0.3*	*1.3*
Ave. 19.00 to 07.00	*0.8*	*0.1*	*0.1*	*1.1*

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

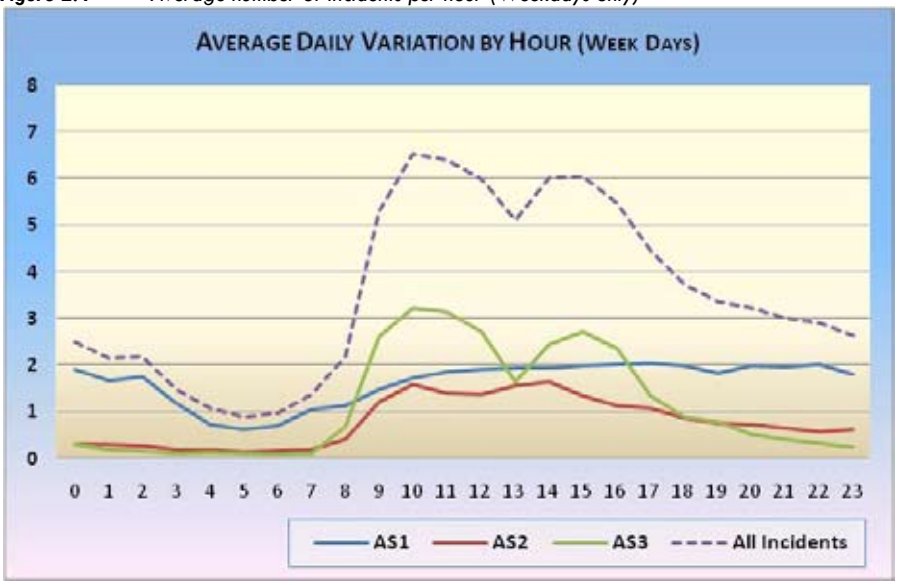


Table 2.6

Average Daily Variation by Hour (Week Days)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***1.6***	***0.8***	***1.1***	***3.5***
Ave. 08.00 to 18.00	*1.8*	*1.2*	*2.2*	*5.2*
Ave. 19.00 to 07.00	*1.5*	*0.4*	*0.3*	*2.1*

At weekends demand on ambulance services from AS1 activity increases while there is a corresponding decrease in AS2 and AS3 demand. The average hourly demand at the weekend is 0.8 AS1 incidents per hour compared to the 1.6 per hour for weekdays only. The average hourly rate of AS3 on Saturdays and Sundays is 0.1 compared to 1.1 per hour for weekdays (see tables 2.5 and 2.6).

The period 23.00hrs to 03.00hrs on weekend nights and the early hours of Mondays (see figure 2.3) are the busiest times for AS1 activity with call rates approaching an average of 2.1 per hour at around 02.00hrs. Day time demand for AS1 services is broadly similar to weekday activity.

2.2.4 AS3 Temporal Variability

AS3 calls make up around 28% of the numbers of incidents recorded in the Southern region. Monthly variation of AS3 demand remains stable throughout the year with a monthly average of 682 calls, the busiest month was January, however no particularly strong pattern of demand emerges.

Per day an average of 22.4 incidents occur (see table 2.7), however figures 2.3 and 2.4 highlight the fact that AS3 activity principally occurs during weekdays and is concentrated into the hours 09:00hrs to 13:00hrs and 14:00hrs to 17:00hrs. For all AS3 incidents 86% of them are required

during weekdays (7060) and of this 70.8% of those incidents (4,997) occur between the hours listed above. Thus during weekdays (Mon – Fri) a daily average of 27 AS3 incidents occurs between 09:00hrs to12:59hrs and 14:00hrs to 16.59hrs.

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

Table 2.7 AS3 Monthly variation

Average Monthly Variation (AS3 Incidents)			
Month	**AS3**	**% of All Incidents**	**Average AS3 Per Day**
January	737	29%	23.8
February	712	30%	25.4
March	755	30%	24.4
April	615	27%	20.5
May	684	28%	22.1
June	635	26%	21.2
July	676	27%	21.8
August	692	28%	22.3
September	672	28%	22.4
October	705	28%	22.7
November	652	27%	21.7
December	653	26%	21.1
Total	**8,188**	**28%**	**22.4**
Average Monthly	***682***		

2.2.5 Temporal Variation Findings

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

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

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

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

- At weekends the highest levels of activity occurred between 00.00hrs and 03.00hrs with AS1 calls dominating the demand profile and a peak in activity at 01.00hrs.

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

2.3 Spatial Analysis of Incidents

The spatial analysis 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.

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

2.3.1 Analysis Framework

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

- Main urban centres (towns greater than 5,000 persons) consisting of:

Cork	Cobh	Carrigaline	Mallow
Midleton	Youghal	Fermoy	Passage West

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

Figure 2.5 *Settlements and current distribution of ambulance stations*

Figure 2.6 *Spatial Typology*

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

In population terms the most current census in 2006 indicated that the entire region had a population of 621,130 persons. From 2002 to 2006 the population of the region increased by 7% (see table 2.8), which is slightly below the national average of 8%. Population growth was strongest in the rural areas with an increase of 8.2% compared to the towns with an increase of around 6.5%. Cork towns had strongest growth where an increase of 6.5% represented an increase of 18,051 people in the four year period. The strengthening of the urban population base in the region corresponds to national trends and has important implications for future emergency care provision.

2.3.2 Spatial Distribution of Incidents (AS1 & AS2)

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

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

Name	Total Population		% Change	No. Incidents (AS1 & AS2)	All Incidents per 100 persons	AS1 incidents per 100 persons
	2002	2006				
Cork						
Towns & Villages	276,007	294,058	6.5%	13,651	4.6	3.6
Rural Areas	166,727	182,153	9.3%	7,011	3.8	2.3
Low Density Rural Area	5,095	5,084	-0.2%	107	2.1	1.2
Total	447,829	481,295	7.5%	20,769	4.3	3.1
Kerry						
Towns & Villages	48,917	51,892	6.1%	2	n/a	n/a
Rural Areas	73,519	77,697	5.7%	25	n/a	n/a
Low Density Rural Area	10,091	10,246	1.5%	0	n/a	n/a
Total	132,527	139,835	5.5%	27	n/a	n/a
HSE South West Area						
Towns & Villages	**324,924**	**345,950**	**6.5%**	**13,653**	**3.9**	**3.1**
Rural Areas	**240,246**	**259,850**	**8.2%**	**7,036**	**2.7**	**1.6**
Low Density Rural Area	**15,186**	**15,330**	**0.9%**	**107**	**0.7**	**0.4**
Total	**580,356**	**621,130**	**7.0%**	**20,796**	**3.3**	**2.4**

Sources*: CSO 2006 & Southern Ambulance service*

The results indicate average rates of incidents per head on population, where for the region as a whole there were 3.3 incidents per 100 persons, this is made up of 2.4 AS1 incidents per 100 persons with the residual, 0.9 being the number of AS2 incidents per 100 persons.

The lack of incident data from the Kerry region gives a skewed view of the overall figures for the region. The incidents that occur in Kerry are near the county boundary with Cork and they are so infrequent that they do not add to the overall analysis in any meaningful way. By including the Kerry population data but not the incident data, the overall rate of incidents per 100 persons for the region is lowered.

The key feature from this analysis is that rates of AS1 and AS2 per capita are higher in urban areas compared to rural areas. Thus for example there were 3.6 AS1 incidents per 100 persons in Cork towns compared with 2.3 per 100 persons in rural areas. An additional feature of the results is that in sparsely populated areas rates of incidents are lower than other rural areas.

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

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

increases, demand for emergency care will increase at higher rates than the per-capita increase in population.

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

There is considerable variation in the levels of incidents that were responded to by the National Ambulance Service Southern region. Established large towns such as Bandon, Cork, Skibbereen and Youghal had rates between 3.7 to 9.6 AS1 incidents per 100 persons, while other large towns, notably Carrigaline and Cobh had significantly lower rates. The rapidly growing towns within Cork's extended commuter belt had lower than average incident rates; this is likely to reflect their younger population profile.

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

Name	Persons 2002	Persons 2006	% Change	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Cork Towns							
Bandon	1,578	1,721	8%	306	17.8	166	9.6
Bantry	3,150	3,309	5%	192	5.8	130	3.9
Blarney	2,146	2,400	11%	45	1.9	32	1.3
Carrigaline	11,191	12,835	13%	205	1.6	148	1.2
Carrigtwohill	1,411	2,782	49%	78	2.8	52	1.9
Charleville	2,685	2,984	10%	205	6.9	110	3.7
Clonakilty	3,698	4,154	11%	102	2.5	46	1.1
Cobh	9,811	11,303	13%	266	2.4	130	1.2
Cork	186,239	190,384	2%	9,637	5.1	8,222	4.3
Crosshaven	1,373	1,669	18%	42	2.5	33	2.0
Dunmanway	1,532	1,522	-1%	103	6.8	44	2.9
Fermoy	4,804	5,873	18%	187	3.2	110	1.9
Kanturk	1,651	1,915	14%	98	5.1	50	2.6
Kinsale	3,554	4,099	13%	112	2.7	58	1.4
Macroom	2,985	3,553	16%	207	5.8	113	3.2
Mallow	8,937	10,241	13%	485	4.7	300	2.9
Midleton	7,957	10,048	21%	382	3.8	244	2.4
Millstreet	1,289	1,401	8%	69	4.9	39	2.8
Mitchelstown	3,300	3,365	2%	182	5.4	79	2.3
Passage West	4,595	5,203	12%	87	1.7	70	1.3
Rathcormac	492	1,072	54%	40	3.7	30	2.8
Skibbereen	2,000	2,338	14%	146	6.2	92	3.9
Tower	3,032	3,102	2%	50	1.6	42	1.4
Youghal	6,597	6,785	3%	425	6.3	266	3.9
Total Cork	**276,007**	**294,058**	**6%**	**13,651**	**4.6**	**10,606**	**3.6**

continued over

Table 2.9 cont

Name	Persons 2002	Persons 2006	% Change	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Kerry Towns							
Ballybunion	1,329	1,365	3%	n/a	n/a	n/a	n/a
Dingle	1,828	1,920	5%	n/a	n/a	n/a	n/a
Killorglin	1,359	1,627	16%	n/a	n/a	n/a	n/a
Cahirciveen	1,272	1,294	2%	n/a	n/a	n/a	n/a
Kenmare	1,844	1,701	-8%	n/a	n/a	n/a	n/a
Castleisland	2,162	2,300	6%	n/a	n/a	n/a	n/a
Listowel	3,999	4,338	8%	n/a	n/a	n/a	n/a
Killarney	13,137	14,603	10%	2	n/a	n/a	n/a
Tralee	21,987	22,744	3%	n/a	n/a	n/a	n/a
Total Kerry	**48,917**	**51,892**	**6%**	2	n/a	n/a	n/a
Urban Total	**324,924**	**345,950**	**6%**	**13,653**	**4.6**	**10,606**	**3.6**

Note: *See table 2.6 for rural population*

2.3.3 Spatial Distribution of Incidents (AS3)

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

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

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

Name	No. AS3 Incidents	AS3 Incidents per 100 persons
Cork		
Towns & Villages	6,156	2.1
Rural Areas	1,837	1.0
Low Density Rural Area	9	0.2
Total	8,002	1.7
Kerry		
Towns & Villages	2	n/a
Rural Areas	3	n/a
Low Density Rural Area	1	n/a
Total	6	n/a
HSE South West Area		
Towns & Villages	**6,158**	**2.1**
Rural Areas	**1,840**	**1.0**
Low Density Rural Area	**10**	**0.2**
Total	**8,008**	**1.7**

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

Of the total number of AS3 incidents (8,113) 7,887 were movements within the region where the pick-up and hospital attended were within the region. In total 203 AS3 incidents were to hospitals or clinics in Dublin, with a small number of movements to other out-of-region hospitals.

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

Hospital attended (To)	Pick up Location (From)												
	Cork City	Mallow	Bantry	Kanturk	Macroom	Youghal	Midleton	Fermoy	Millstreet	Clonakilty	Skibbereen	Castleto-wnbere	Total
Cork University Hospital	920	590	311	80	90	86	109	60	53	99	33	8	2,439
Mercy University Hospital	381	600	32	162	43	30	44	60	65	16	10		1,443
Mallow General Hospital	11	536	1	148			1	33	52				782
St Finbarr's Hospital	484	10	3	3	33	6	22	8	24	6		1	600
St Mary's Ortho. Hospital Cork	421	7	7	8	41	8	9	8	24	7	2	1	543
South Infirmary Victoria	259	9	22	7	30	28	26	13	13	11	2		420
Bantry General Hospital	5	2	199		4	1				56	84	40	391
St Patrick's Hospice Marymount	156	2		2	20	8	10	15	2	2			217
Bons Secours Hospital Cork	33	67	3	8	16	3	7	5	6	3			151
Clonakilty Hospital	3		30	1	1					58	12	2	107
Skibbereen Hospital	1		13							9	75	2	100
Crumlin Hospital Dublin	85								1				86
Other Hospitals within SW region	109	51	39	68	42	130	64	87	45	15	14	20	684
Other Hospitals outside SW region	10	12			1	1			1				25
Dublin Hospitals	89	8	1	4	4	2	5		2		2		117
Unspecified	5		3										8
Total	***2,972***	***1,894***	***664***	***491***	***325***	***303***	***297***	***289***	***288***	***282***	***234***	***74***	***8,113***

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

- That patient transport services are dominated by transport from inter-hospital transport between Cork City and Cork University Hospital and Mallow and The Mercy University Hospital.
- Cork City has the highest number of incidents relative to resident population and the highest total volume of AS3 incidents in the region.
- Trips for patients attending Dublin hospitals represent around 3% of the total volume of AS3 activity.

3. Performance Analysis

3.1 Performance Standards

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

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

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

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

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

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

Ireland's settlement structure and urban hierarchy is significantly different to the UK and direct translation of these definitions of urban and rural locations may not be appropriate. In the case of the Southern region 99% of the area has a population density of less 20 persons per Km^2 and contains 19% of the total resident population. Equally while there are some strong urban settlements, in general the urban structure is weak and the population is dispersed. Furthermore the distinction between Category 'A' and Category 'B' calls are not equivalent to the distinction

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

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

3.2 Response Times in the Southern region

The average (median) response time for the study period for the entire Southern region was 20.4 minutes for all AS1 & AS2 incidents combined. For AS1 the median response time for all incidents was 17.8 minutes and 23.1 minutes for AS2 incidents. The percentage incidents responded to within certain time bands provides a better means of examining response targets and these are presented below.

3.2.1 Response Time

For the entire region 17% of AS1 incidents are responded to in less than eight minutes and 5% of AS2 incidents. In the main settlements this raises to 20% of all AS1 incidents (4% AS2) whereas in rural locations 10% of AS1 calls were responded to in eight minutes (see tables 3.1 & 3.2).

Table 3.1 Response times by spatial typology for AS1 incidents

Spati al Type	% of AS1 Incidents Responded by					% of all
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	Incidents
Main Towns	20%	40%	16%	9%	15%	65%
Small Towns	18%	14%	13%	17%	37%	7%
Rural Area	10%	20%	20%	18%	32%	28%
Sparse Rural Area	2%	7%	12%	20%	60%	0%
Region Total	**17%**	**32%**	**17%**	**12%**	**22%**	**100%**

Table 3.2 Response times by spatial typology for AS2 incidents

Spati al Type	% of AS2 Incidents Responded by					% of all
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.	Incidents
Main Towns	4%	13%	13%	14%	56%	38%
Small Towns	9%	11%	5%	11%	63%	13%
Rural Area	4%	8%	9%	12%	67%	48%
Sparse Rural Area	0%	2%	4%	15%	79%	1%
Region Total	**5%**	**10%**	**10%**	**13%**	**63%**	**100%**

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

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

Response times of less than 19 minutes are achieved for 66% of all AS1 incidents (25% for AS2) for the region as a whole. Over 76% of AS2 incidents are being responded to in more than 19 minutes, while improvements in response times for AS2 incidents is desirable, additional refinement of the level of 'urgency' associated with particular AS2 incidents is required in advance of initiatives that aim to reduce the response time for this category of incident.

Within the Southern region the response rate for County Cork is at 17% of AS1 calls achieving a response time of less than eight minutes. County Kerry figures relate only to a small number of incidents near the county boundary with Cork which were picked up by the Cork Ambulance Service. These figures do not add significantly to the overall analysis and in future studies the Kerry data will need to be included to give a more accurate overall picture for the region.

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

Location	% of AS1 Incidents Responded by				
	8 Mins.	14 Mins.	19 Mins.	25 Mins.	> 25 Mins.
Cork					
Towns & Villages	20%	37%	16%	10%	17%
Rural Areas	10%	20%	19%	18%	33%
County Total	17%	32%	17%	12%	22%
Kerry					
Towns & Villages	0%	0%	50%	0%	50%
Rural Areas	13%	13%	6%	31%	38%
County Total	11%	11%	11%	28%	39%

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

At the level of the eight main settlements the presence of an ambulance station has a significant impact on the response times for AS1 incidents. Table 3.4 lists the AS1 response times for the main settlements; Carrigaline, Cobh and Passage West have significantly less eight minute response times achieved than the other towns, with percentages of incidents responded to within eight minutes being less than 3%, whereas for the other four settlements around 20% and above of the AS1 incidents were responded to within eight minutes.

Table 3.4 AS1 response times for Main Settlements

Spatial Type	% of AS1 Incidents Responsed by				% of all Incidents
	8 Mins.	14 Mins.	19 Mins.	> 19 Mins.	
Carrigaline	1%	14%	39%	24%	1.0%
Cobh	3%	4%	16%	26%	0.9%
Cork	20%	43%	16%	8%	55.4%
Fermoy	29%	24%	12%	9%	0.7%
Mallow	17%	32%	15%	17%	2.0%
Midleton	27%	22%	15%	16%	1.6%
Passage West	1%	20%	43%	13%	0.5%
Youghal	38%	25%	13%	9%	1.8%

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

4. Tactical Deployment Planning and Resource Assessment

4.1 Description of goals of Tactical Deployment Planning

4.1.1 Objectives

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

4.1.2 Outline of software systems

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

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

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

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

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

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

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

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

4.2 TDP - Steps in Creation

4.2.1 Identify best vehicle positions and compare with existing stations

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

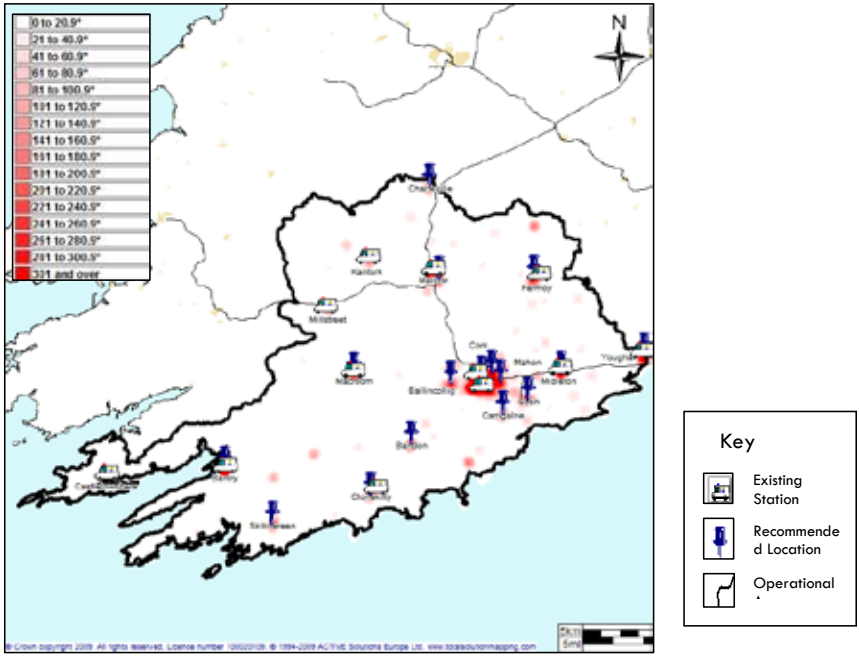


FIG 4.1 Shows the locations of existing stations and recommended demand based response origins. 500m grid squares are coloured from white to red to show the density of incidents.

4.2.2 Response Footprint Formation

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

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

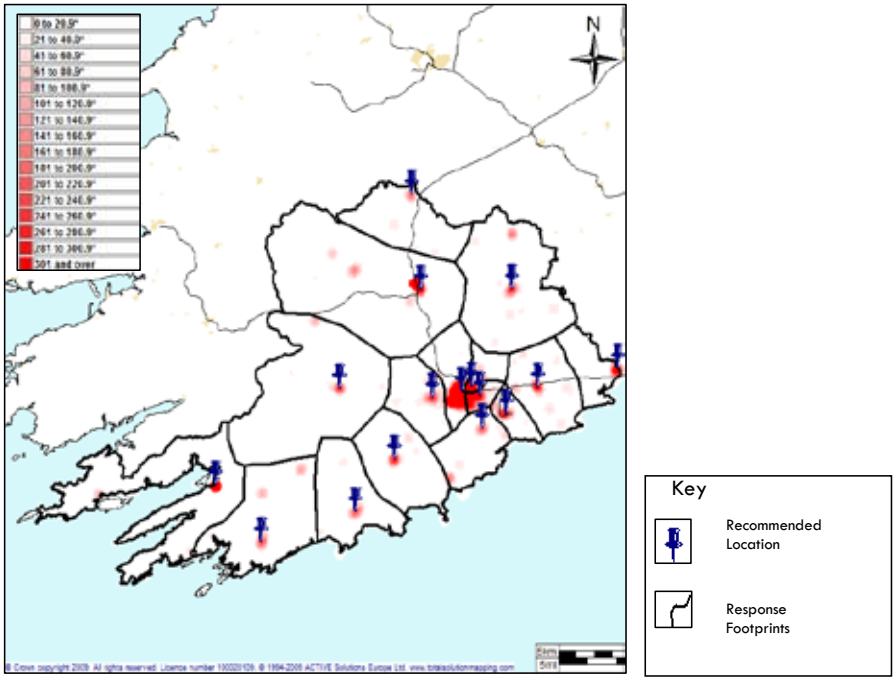


FIG 4.2. shows the locations of recommended demand based response origins and response footprints around each. 500m grid squares are coloured from white to red to show the density of incidents.

4.2.3 Tactical Deployment Plan

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

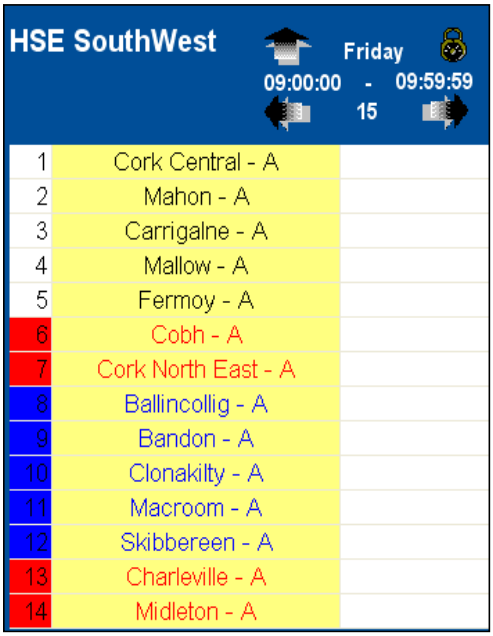


FIG 4.3 *TDP on Friday 09:00am-09:59am*

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

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

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

4.3 Current Resource and Performance

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

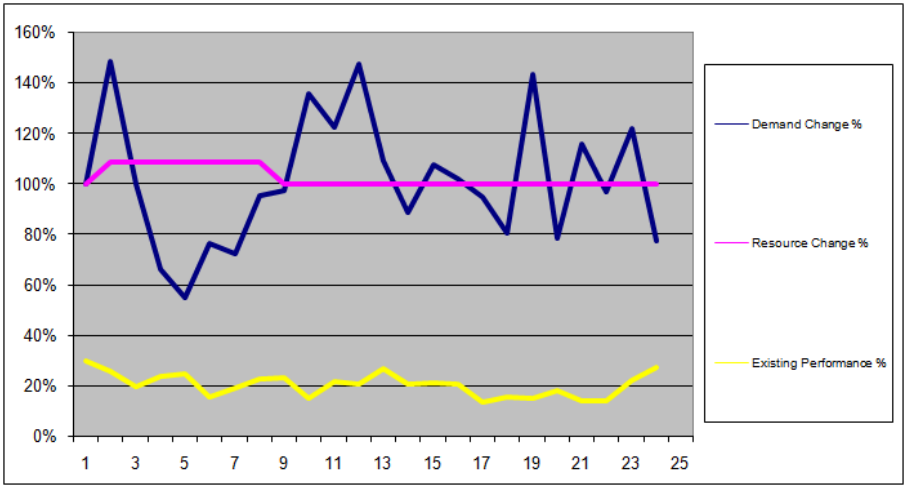
The table below shows the current number of scheduled emergency vehicles available for all workload set out by hour for an average working week. This is derived from resource figures and crewing arrangement provided by the HSE Southern Region Ambulance Service.

Table 4.1

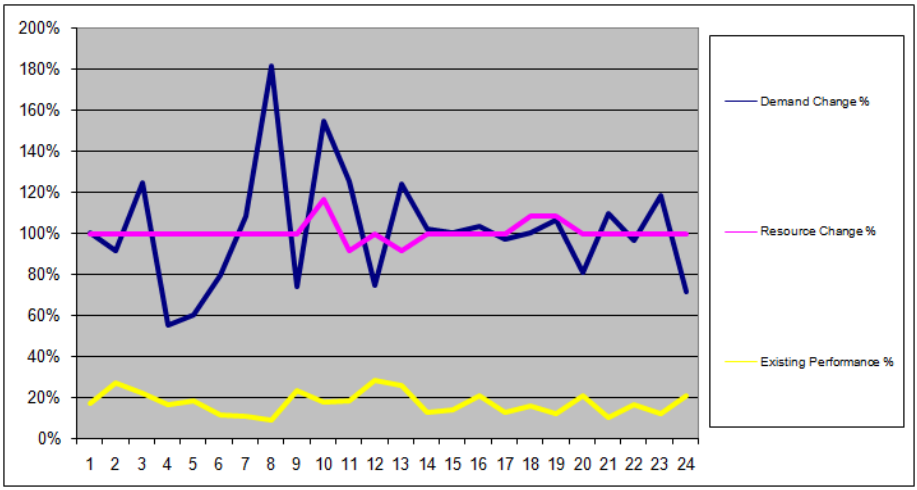
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday	14	15	15	15	15	15	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Monday	14	14	14	14	14	14	14	14	14	16	16	16	16	16	16	16	16	16	15	14	14	14	14	14
Tuesday	14	14	14	14	14	14	14	14	14	15	16	16	16	16	16	16	16	16	15	14	14	14	14	14
Wednesday	14	14	14	14	14	14	14	14	14	15	16	16	16	16	16	16	16	16	15	14	14	14	14	14
Thursday	14	14	14	14	14	14	14	14	14	15	16	16	16	16	16	16	16	16	15	14	14	14	14	14
Friday	14	14	14	14	14	14	14	14	14	15	16	16	16	16	16	16	16	16	15	14	14	14	14	14
Saturday	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	15	15	15	15

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

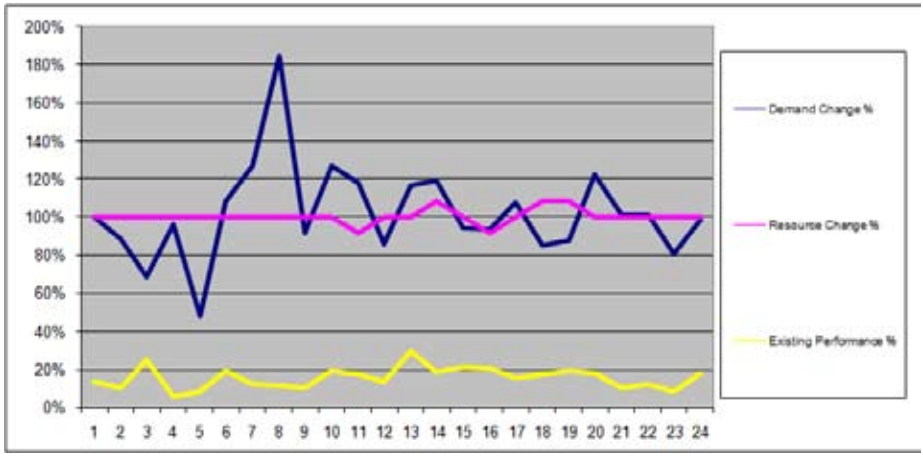
Sunday



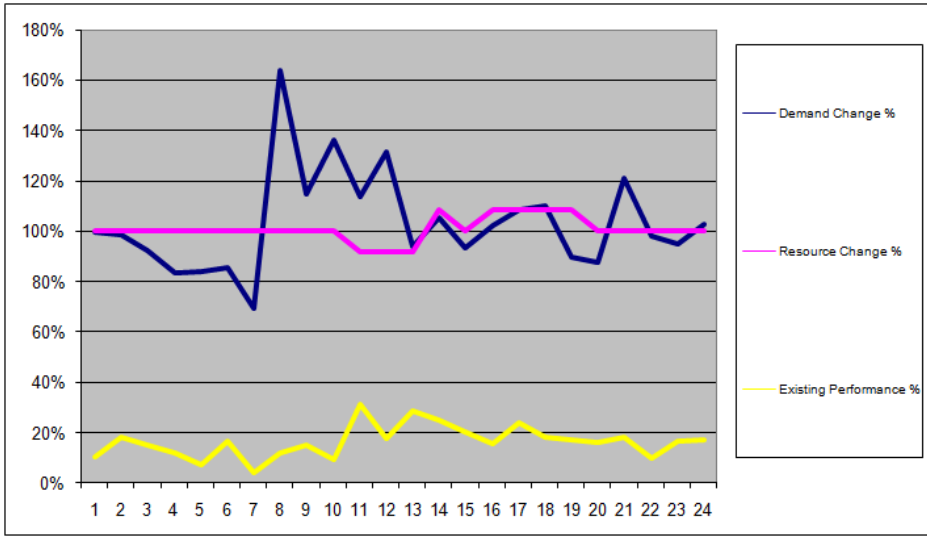
Monday



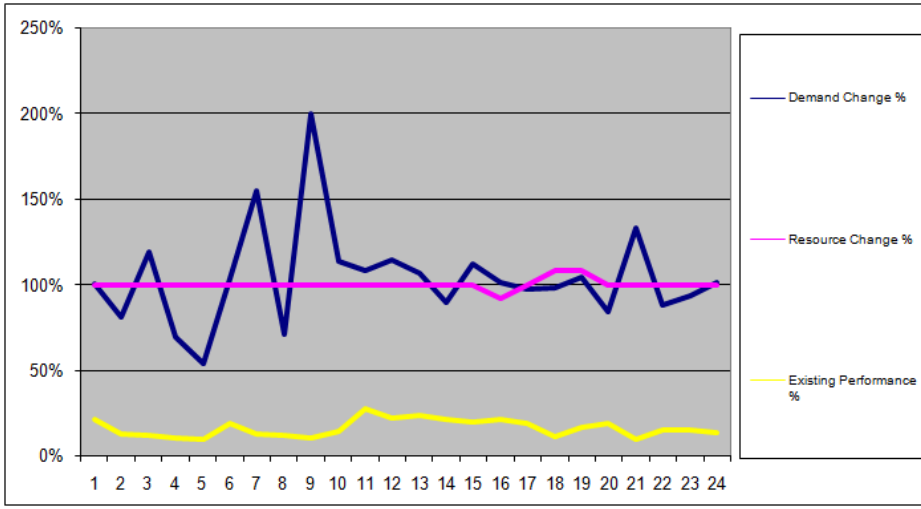
Tuesday



Wednesday

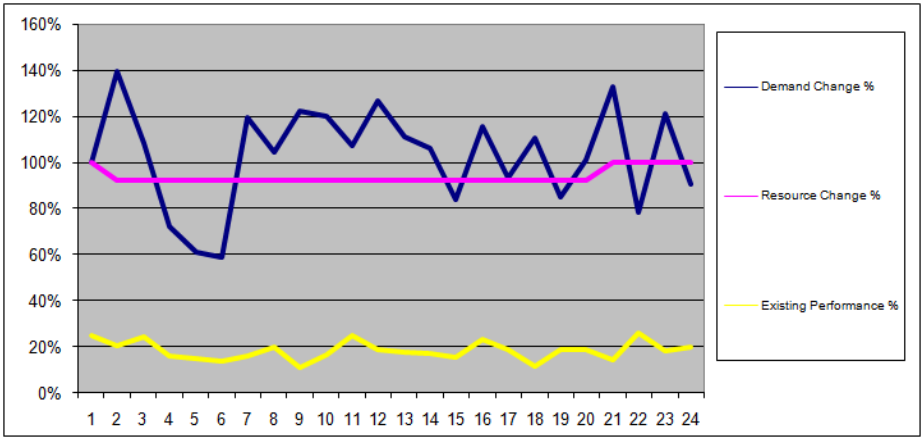


Thursday



Friday

Saturday

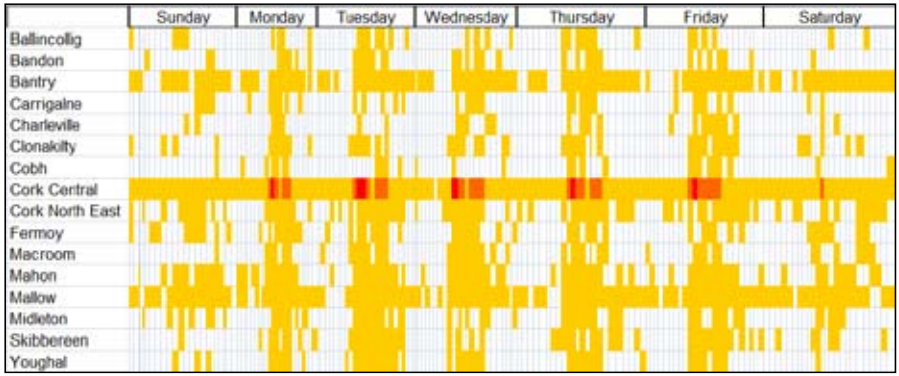


Across all of the days of the week the increase in the number of resources comes slightly too late in the morning, and consideration should be given to bringing the steep increase in resources forward by one or two hours.

4.4 Impact of PTS Workload

This section aims to give an insight into the impact of using emergency resources for routine patient transport work. HSE Southern region knows that the absence of an intermediate care or PTS fleet is draining the emergency resources available to the ambulance service for emergency work. Using the PTS dataset the actual effects can be studied.

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



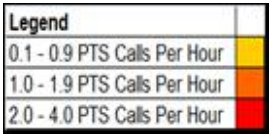


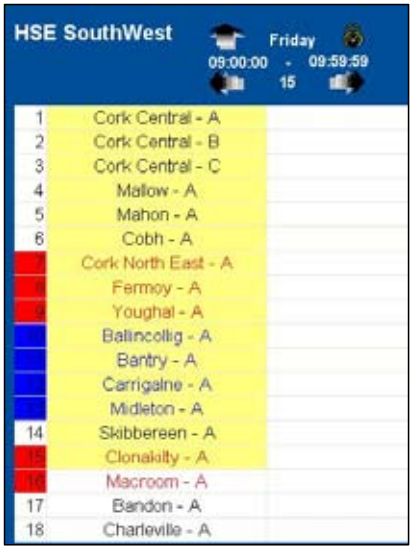
FIG 4.4 *Geographical and temporal spread of PTS workload*

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

The TDP is calculated including and excluding the PTS work. As the matrix suggests, the top prioritised vehicle would be needed in Cork Central, because the demand is higher than anywhere else.

Figure 4.5 is for Friday morning 09:00am – 09:59am. It shows considerable difference between the two plans. When the PTS incidents are excluded from the plan 16 resources will be required to cover all the incidents. When the PTS incidents are included 18 resources are required to cover all the incidents and multiple resources are required at the same location. For example the first three resources are required for Cork Central to cope with the demand.

Including PTS



Excluding PTS

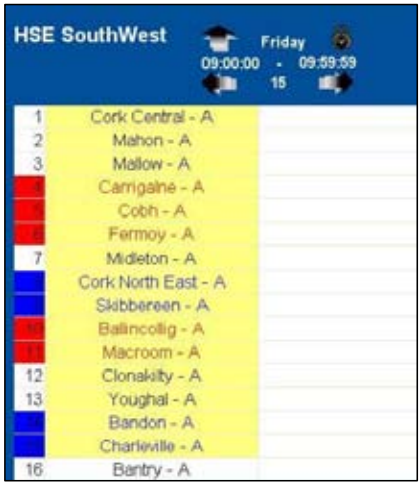


FIG 4.5 *Impact of PTS workload on the TDP*

4.5 Tactical Deployment Plan Impact Analysis

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

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

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

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

This assumes that PTS work is not carried out by emergency vehicles unless the clinical needs of the patient genuinely require an acute care transportation. This means clear to clear times are reduced to an average of 74 minutes and more vehicles will be available. Again, an abstraction factor of 35% is built in to reduce the number of vehicles further, to allow for vehicles off road, sickness, meal breaks etc.

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

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

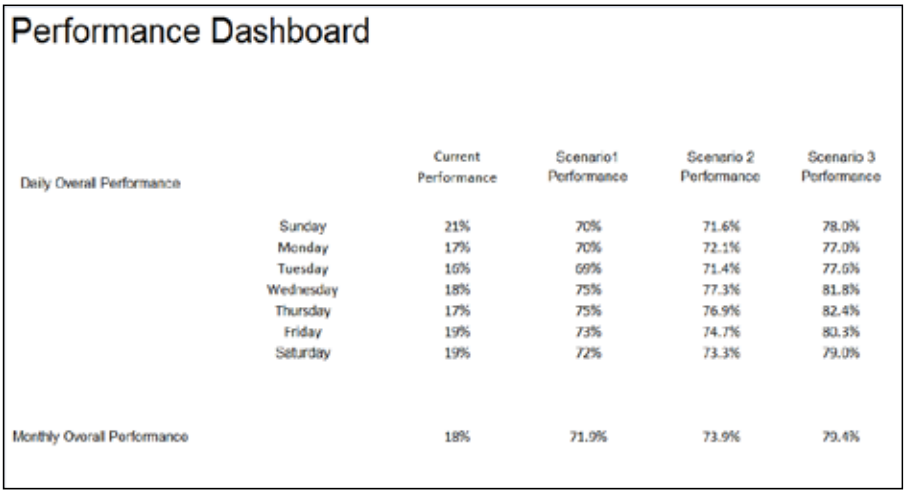
4.5.1 Performance Forecasts

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

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

In the absence of MPDS codes or CBD codes, AS1 incidents are assumed to be life threatening. This is quite a broad assumption and some (or perhaps many) AS1 calls may not be life threatening emergencies. Current performance forecasts are likely to be higher if life threatening incidents could be extracted from the data in the future.

Figure 4.6 shows the current and the forecast performance for the different scenarios as previously described, against a response standard of eight minutes for all Category A incidents. With the current level of resources, the forecast performance in Scenario 3 is 79.4%. All of these forecasts assume an average of two minutes activation time.



Performance Dashboard

Daily Overall Performance		Current Performance	Scenario1 Performance	Scenario 2 Performance	Scenario 3 Performance
	Sunday	21%	70%	71.6%	78.0%
	Monday	17%	70%	72.1%	77.0%
	Tuesday	16%	69%	71.4%	77.6%
	Wednesday	18%	75%	77.3%	81.8%
	Thursday	17%	75%	76.9%	82.4%
	Friday	19%	73%	74.7%	80.3%
	Saturday	19%	72%	73.3%	79.0%
Monthly Overall Performance		18%	71.9%	73.9%	79.4%

Fig 4.6 *eight minute response time for AS1 incidents (current resource provision)*

Summary

- Implementing the TDP should improve responsiveness to emergency demand by 54.1% points.
- If an intermediate care fleet was introduced to take care of all PTS workload, a further 2.3% point increase in the number of AS1 calls responded to in 8 minutes or less can be expected.
- Reducing the abstraction factor could move the ambulance service on by another 5% points.

4.5.2 Impact of Additional Vehicles

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

If resources are unlimited, then the best performance is 80% which is constrained not by available resources, but by the limited number of locations available to place the resources.

Thereafter, further performance gains will be available by the addition of resources, and the wider distribution of the response origins to amplify coverage in the wider, rural areas. Estimates in this respect will only be possible on repeat of the TDP exercise for additional vehicles.

Table 4.2

Additional Impact of 1 Vehicle (Emergency)			
Current	**Scenario 1**	**Scenario 2**	**Scenario 3**
0.00%	**1.4 – 1.6**	**0.2 – 0.4**	**0.6 – 0.8**

Summary

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

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

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

5. Demographic Trends and Service Hierarchy Implications

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

5.1 Demographic and Regional Trends

5.1.1 Context

The HSE Southern Region of Ireland consists of counties Cork and Kerry. It covers a geographic area of 12,161 sq. kilometres and has a population of 621,130[3]. The region has a unique and diverse socio-cultural heritage with its population living in a range of settlements from modern urban settings to small rural towns, isolated farms and islands just off the coast. Approximately 54% of the population reside in urban areas, which is marginally below the state average of 60%. Cork City, with its population of 119,418 is the second largest city in Ireland and therefore plays a vital economic and social role.

The population of Cork City decreased marginally in between the 2002 and 2006. In 2002 the population was 123,062 meaning that a decrease of 2.9% occurred during the years leading to 2006. While this may seem a cause for concern, in reality the population has shifted to more suburban and commuter-type dwellings, with the populations of commuter towns increasing at a rapid pace during these years. The Regional Planning Guidelines for the Southern region state that the vast majority of towns in the region have experienced population growth in the inter-censual period.

In terms of towns of significance, Mallow town has been designated a hub, together with the designation of Tralee/Killarney as a joint hub in the National Spatial Strategy (NSS), and so these together with the designation of Cork City as a gateway, seek to encourage positive planning and development of the region to ensure competitiveness and sustainability to counter the imbalance created by the focus of industry in Dublin.

The HSE Southern Region covers the same geographic region as the Regional Planning Guidelines for the Southern region. The area is now renowned for pharmaceutical and software industries that have increased the economic opportunities of the region.

The Cork Area Strategic Plan (CASP) designates the Cork Metropolitan Area as a major area of growth. This area is the core of the region and is the main driver of economic activity in the Southern region. To achieve this, it is vital that the Southern region continues to develop as a vibrant region with a high quality of life, infrastructure and services. The CASP has a planned population of 216,000 by 2020 in place for the Cork Metropolitan Area. Employment is set to grow to 160,000 in line with projected investment contained in the CASP. Such growth will require infrastructural investment to ensure that quality of life is not hampered.

5.1.2 Population

In 2006 the population of the Southern region was 621,130 persons. This represented an increase of 40,774 persons from the 2002 figure (580,356). The greatest percentage increase during the 2002 to 2006 period was in County Cork, where a population increase of 7.5% was recorded.

[3] CSO 2006 Population Statistics.

County Kerry recorded the slightest percentage population increase over the period, standing at 5.5%. Both counties were below the national average of 8%.

The region has a number of inhabited islands and the undulating topography of the region means that a proportion of the population reside in remote mountainous locations. Dependency rates in this region are largely in line with the State average of 31.4%. Cork county has a dependency rate of 31.5% and Kerry county has a rate of 33.3%. Dependency rates signify the rate of population that are deemed to be 'dependant' on the State for service provision. This is because such persons are outside the employment category and are either under 16 or over 65. The proportion of the population described as 'old' (i.e. those 65 years and over) is set to increase by two-thirds in all regions by 2021 according to the CSO Regional Population Projections. This will impact on service provision in that more acute services will be required for an overall less mobile population.

The population projections for the region in 2021 are listed below. The Regional Planning Guidelines for the Southern region have a prediction of a total population of 700,000 in the region in 2020. The National Spatial Strategy has a forecasted population of around 740,000 in the region as a whole, of which up to 450,000 could live in Cork City and its hinterland.

Fig 5.1 *CASP Strategic Planning Areas*
(extract from Southern Regional Planning Guidelines 2004)

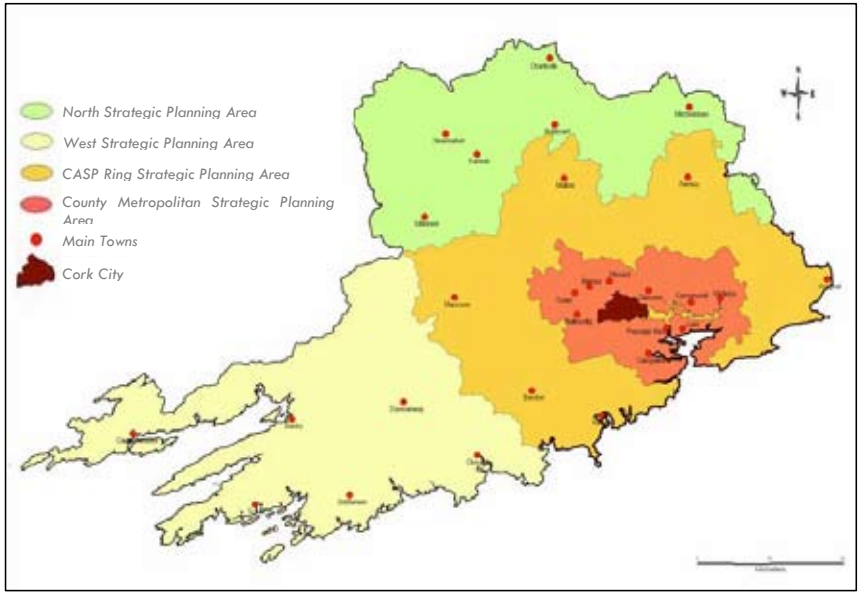


Table 5.1 Cork County Development Plan 2009 Population Projections

Cork Co Development Plan 2009				
Cork	Census		Target	
	2002	2006	2015	2020
County Metropolitan	134,293	153,123	194,643	216,240
CASP Ring	92,033	105,055	111,093	121,760
CASP North	44,286	46,428	51,130	53,885
CASP West	54,155	57,271	63,071	66,469
Total	***324,767***	***361,877***	***419,937***	***458,354***

Source: CSO 2007, Cork County Development Plan 2009

Table 5.2 SW RPG Population Projections

South West Regional Population Guidelines Projections		
Area	2002 (actual)	2020 (projected)
Cork City	123,338	136,000
Cork County	324,850	385,000
County Kerry	132,424	149,000
Region	***580,612***	***670,000***

Source: Regional Population Guidelines 2007

Table 5.3 Kerry County Development Plan 2009 Population Projections

Kerry County Development Plan Population Projections					
Area	2002	2006	2012	2015	2020
County Kerry	132,527	139,835	151,647	160,785	176,016

Source: CSO 2007, Kerry County Development Plan 2009

5.1.3 Spatial Implications

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

5.2 Policy Documents

National Spatial Strategy:

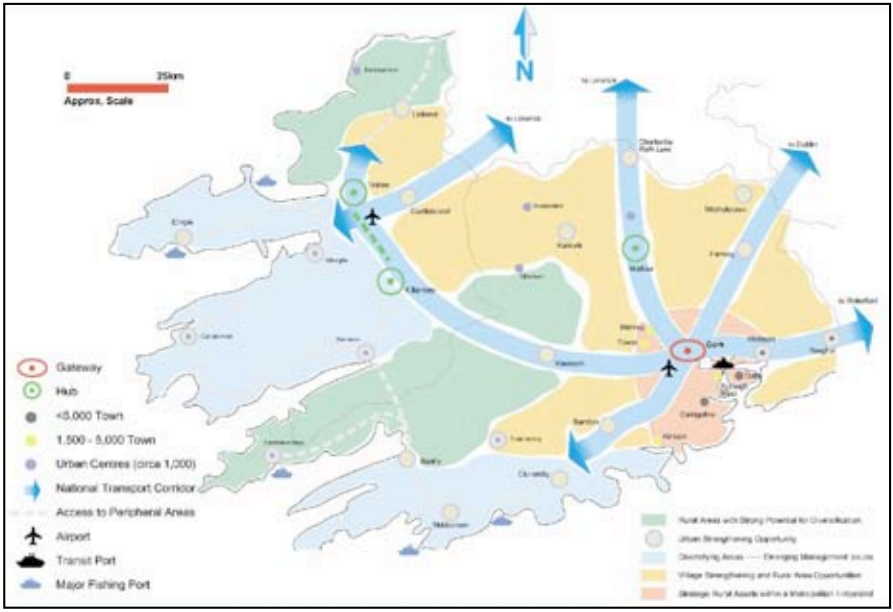
The NSS states that Ireland needs to increase its critical mass by strengthening the regions outside of Dublin. The South, South East and West have been named as requiring development of their potential to complement and counter the success of Dublin. The NSS states that of all the regional cities at present, Cork has the most potential to be developed on a national scale. The NSS states that the direction offered in the CASP will set Cork up for such development. For Cork to achieve its designated level of success, then transport and infrastructure are to play a key role. Improving

links between Limerick and Cork will be vital. Together, these two cities with their two universities and access to two international airports could have a total population of 700,000 people.

The NSS states that areas such as the Southern region have been revitalised by the diversification of the rural economy and that to support this revitalisation, the linked hub of Tralee/Killarney will be a key factor. The tourism sector plays a large role in this region. However, the region lacks many basic infrastructural facilities in a number of locations. To achieve its full potential, such infrastructural deficits must be addressed.

Overall Cork City as a gateway along with Mallow and Tralee/Killarney as hubs will support the development of this region. Towns within the CASP zone of influence will also grow significantly and will play increasing roles in the overall sustainability of the region.

Figure 5.2 N.S.S. Southern Region Planning strategy



(Source: National Spatial Strategy 2002 – 2020)

National Development Plan 2007-2013:

The National Development Plan (NDP) provided that the Southern region together with the Dublin Region and the Mid-Western region experienced the lowest growth rates in the years approaching the 2006 Census. The region must enhance its competitiveness if it is to affectively compete with other regions with influential cities such as Waterford and Galway. Regional Aid has been reduced for this plan due to the increasing prosperity of Ireland as a whole. As such, aid for the Southern region has been reduced. Kerry will receive aid only for small and medium-sized firms while Cork will receive aid for small, medium and large firms for 2007-2008 only. Cork City Docklands has been designated as an urban regeneration area and will be entitled to funding for small and medium firms up until 2013.

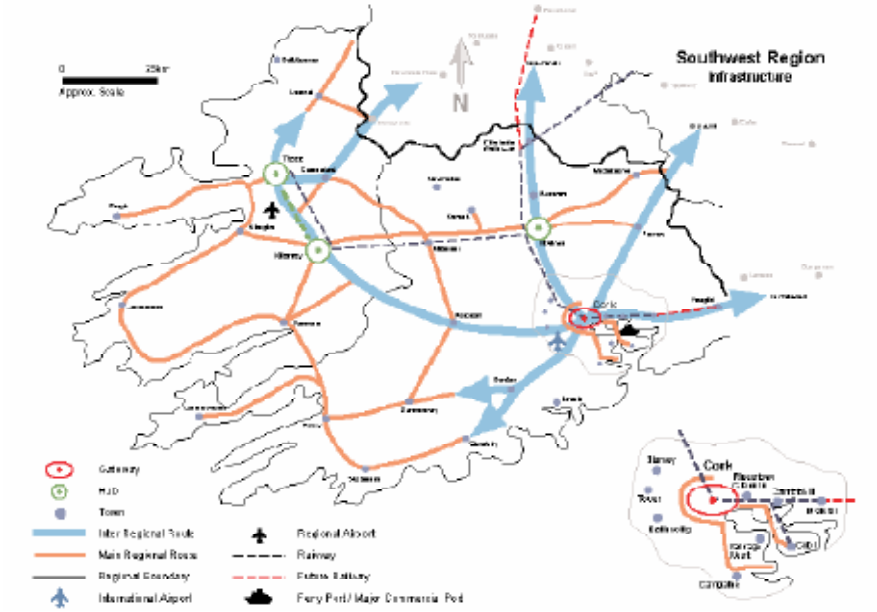
The Gateway Innovation Fund (GIF) which provides additional funding for gateways will allow grant aid into the region via investment in Cork. The main challenge for Cork will be to address its recent decrease in population plus its need to accelerate its growth rate. The Docklands has been earmarked for development and the NDP states that it has the potential to accommodate a population of at least 15,000 persons together with significant commercial floor space. Completion of the Cork/Dublin motorway will be a key aspect to the development of Cork as a gateway and indeed as the second city of Ireland. The enhancement of routes along the Atlantic Gateway will also be crucial to the successful development of this and surrounding regions.

The National Development Plan has a number of initiatives for the development of rural communities. The proportion of the population residing in rural locations in this region is above the national average. Rural life plays a vital part of many localities within this region including the vast area of West Cork and many parts of Kerry, together with the islands. Particular interventions in support of rural areas include investment in broadband, non-national roads, investment in the Rural Transport Initiative and Rural Water Services. Social exclusion in rural areas is also being tackled by the RAPID Programme. Also of particular interest to the Southern region is an investment programme totalling €457 million for enterprise and infrastructure investment in Gaeltacht and Island Communities.

Regional Planning Guidelines for the Southern:

The Regional Planning Guidelines provide that outside of Cork City, Mallow, Youghal, Bandon, Fermoy and Tralee and Killarney in Kerry are the main large towns in the Southern region. These towns have strategic roles in the region and any choice regarding the location of health services will require an assessment of the overall advantages and disadvantages of these towns. These guidelines state that in economic terms, the region is heavily dependent upon pharmaceuticals and tourism. While the services sector and the manufacturing sector have taken off in the region in the past, economic progress has been spatially uneven. The CASP area has dominated Foreign Direct Investment (FDI) which is largely to be expected. Competitiveness throughout the region must be enhanced to ensure that development and quality of life within the region is equitable.

Fig 5.3 *Southern Regional Planning Strategy*
(extract from Southern Regional Planning Guidelines 2004)



The upgrading of routes has been earmarked as central for the development of the region. The N20 Cork/Limerick route, the N22 Tralee/Cork route and the N21 Tralee/Limerick route are central to ensuring that the Atlantic Arc is functionally connected. Linkages between the gateway and hubs and other strategic towns in the region, along with connections to the CASP area will all be vital to increasing connectivity within the region and to other regions. Achieving critical mass as required and addressing declining sectors such as fishing and farming will pose significant challenges for the region. At present, a major challenge is the relative fall in family incomes in the Southern region vis-a-vis other regions. Ensuring adequate and equitable social service provision and creating employment will be the key means of addressing this issue.

Cork County Development Plan 2003-2009:

The County Development Plan states that a strong network of settlements is important for the sustainable development of the county. While Cork county has a large collection of settlements, only 48.7% of the population lives in aggregate town areas. This means that just under half of the population resides in towns with a population in excess of 1,500 persons. This presents a number of challenges regarding service provision given the rural nature of the population. In relation to healthcare provision, the development plan states that it is the policy of the Council to encourage the integration of such services into new or existing communities. This is to reduce unnecessary isolation and to reduce unnecessary access difficulties by all persons but especially the disabled and the elderly.

Given that approximately 65% of the county's population resides on or adjacent to the county's 1,094 kilometres of coast, service provision for this section of population will play a central role to any consideration regarding service location. Also, seven islands off the coast are inhabited, making healthcare provision more complicated.

The Draft Cork County Development Plan makes a number of new and refreshing statements regarding healthcare provision in the county. It states that as it is now the policy of the HSE to make it easier for people to access cost effective and high quality health services, there will be a re-balancing of the system from more traditional hospital based care. Instead, there will be a re-direction of care to the most appropriate settings. There will be continued development of Primary Care Teams and more out-of-hours GPs provided.

The Council is seeking to ensure that the necessary built facilities are provided to ensure that such objectives are met. Again, unnecessary isolation is to be avoided. This is a renewed approach to healthcare provision and spells a new era. As many of these services require site specific criteria, it will be necessary that proper planning ensures that optimal locations are chosen.

Kerry County Development Plan 2003-2009:

Kerry has a unique settlement pattern with much of it population dispersed throughout the county. Only 35.2% of the county's population resides in aggregate town areas, compared to the national average of 60%. One off rural housing is described in the Development Plan as a significant problem together with the fact that 2002 Census indicated that many villages in rural areas were in decline. A main policy objective is therefore to make settlements more attractive places to work and live. Focusing development along the Tralee/Killarney route is a key policy aim of the plan in order to provide the impetus for the future development of the county. In relation to economic development, the plan states that the Tralee/Castleisland/Killarney Corridor is designated as the economic development corridor to lever investment into the area and to aid the development of the overall county.

The plan states that the low density of population in Kerry and the relatively low level of urbanization account for the high dependency on the county's road infrastructure. The county must improve its road infrastructure however if it is to provide a stronger and more viable base for economic development. The plan states that the Local Authority will work in conjunction with the HSE Southern Health Board to locate health and social services in the most appropriate location.

Cork City Development Plan 2004-2010:

The Cork City Development Plan states that it will generally support the development and expansion of healthcare facilities in the city as such facilities should be accessible to city residents. It states that the Council will be favourably disposed to locating such facilities in areas of regeneration such as the City Centre or the Docklands. The location of such services should be in accordance with sustainable transport routes to ensure that access is not restricted to persons such as older persons or those with a disability. This is especially true given that the main hospitals in the Southern region are located in Cork City. These hospitals are to undergo some rejuvenation with the Cork University Hospital (CUH) expanding rapidly, with services expected to double over the lifetime of the development plan. In the city also, healthcare is shifting from traditional hospital-based services to more community oriented facilities. Community services such as health centres, sheltered housing, family resource centres, and youth work programmes, residential care centres for children and those with mental and/or other disabilities will all be promoted by the City Council. Primary care services are coming to the fore and the Cork City Development Plan is aiming to ensure that they are developed in the most sustainable manner possible. Accessibility by public transport will be a main consideration.

National Roads Authority:

The National Roads Authority (NRA) was formally established as an independent statutory body under the Roads Act 1993. Its primary function is the provision of safe and efficient road systems throughout the country. For this purpose, it has the overall responsibility for the planning and supervision, construction and maintenance of such roads. The provision of such infrastructure can add to the development of certain areas and the provision of routes in the Southern region in the immediate future will prove vital to its progression and indeed its overall sustainability. The following road schemes are underway in counties Cork and Kerry.

County Cork:

Scheme	Status
N8 Cashel Mitchelstown	Complete
N8 Mitchelstown Relief Road	Complete
N8 Mitchelstown Fermoy	Construction
N8 Fermoy Watergrasshill	Complete
N20 Mallow to Croom	Preliminary Design
N22 Cork Northern Ring Road	Preliminary Design
N22 Ballyvourney Macroom	Preliminary Design
N22 Ballincollig Bypass	Complete
N25 Cork SRR Interchanges	Preliminary Design
N25 Carrigtwohill Midleton	Preliminary Design
N25 Midleton to Youghal	Constraints Study
N25 Kinsale Road Interchange	Complete
N28 Ringaskiddy to Cork	Preliminary Design
N71 Bandon to Inishannon	Constraints Study

County Kerry:

Scheme	Status
N21 Castleisland to Abbeyfeale	Complete
N21 Ballycarty to Tralee	Complete
N21 Castleisland Bypass	Tender
N22 Gortatlea to Farranfore (Inchinveema)	Complete
N22 Tralee Bypass	Preliminary Design
N22 Farranfore to Killarney	Preliminary Design
N23 Castleisland to Farranfore	Constraints Study

5.3 Development Trends Summary

The Southern region can be described as rural in nature with 54% of its population residing in such locations. It also qualifies as rural as several locations throughout the region are very isolated from the core urban areas such as Cork City, the designated hubs or large towns within the region.

It is vital that such isolated locations are protected from depopulation and declining quality of life. This, together with the requirement to reach critical mass in a number of locations will pose great challenges for the region. Service provision to such rural locations is also an issue of concern. Road infrastructure is inadequate in a number of areas within the region and healthcare provision to areas such as inhabited islands and communities in mountainous terrain pose a number of economic and ethical challenges.

The main hospitals for the Southern region are located in Cork City which is removed from a number of rural locations especially rural West Cork and Kerry. As such, progress shifting healthcare to more community-based primary care is a significant development for healthcare provision in the region.

6. Conclusions & Recommendations

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

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

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

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

R1) Transfer methods of analysis to other regions:

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

R2) Future Data Capture and Patient information:

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

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

R3) TDP Implementation Support:

The TDP developed in this study has demonstrable significant potential benefits for enhanced responsiveness to emergency incidents in the Southern region. The analysis demonstrated that without any additional crew or vehicle resources a 54% increase in achieving AS1 response times in less than eight minutes was likely. Management and staff support, together with appropriate training and consultation, is required to implement the TDP. In addition to a number of technical issues (principally concerning exact positioning 'response origins') there are significant changes in operational practice within the ambulance service that require management guidance. Ongoing support from all agencies concerned is required to ensure its successful implementation.

R4) Inter-regional methodology:

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

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

R5) Revision of TDP:

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

R6) Operational Implementation of TDP:

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

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

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

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

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

R8) Addressing future demands

The analysis has demonstrated that high demand arises in urban centres and with continued strong population growth expected in the principal urban centres, that provision of future resources should be aligned to equitably address this growth. The TDP highlighted a requirement for changes to the configuration of ambulance response origins in particular for North County Cork, Cork City and East Cork.

Inter-regional analysis may prove that existing facilities in adjoining centres in particular in relation to services in West Limerick/North Cork County.

R9) Patient Transport Service & Inter-agency consultation:

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

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