Evaluation of Options for Primary Emergency Care Provision in the HSE North-Eastern Area

Pre-Hospital Emergency Care Council

July 2005

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A Report for the

Pre-Hospital Emergency Care Council

and the

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1 Introduction

1.1 Background

The aim of this study is to identify spatial configuration options for Ambulance services that will assist in reducing the cumulative times for the delivery of emergency care to patients.

The study uses the term Spatial Cover[1] to identify geographic areas that represent service areas from each Ambulance station. Theoretical models of emergency care provision are developed that illustrate response times for Ambulance services and the relationships with locations of secondary emergency care centres. The models assume that all current Ambulance stations (see Table 1) provide 24/7 cover and that these can provide full service at all times. The study also assumes that Secondary Emergency care is provided only in Our Lady of Lourdes Hospital Drogheda and Cavan hospital within the region, but that patients requiring secondary emergency care will be transported to neighbouring centres (in other HSE areas or in Northern Ireland) if they can be reached in less time than those centres.

In December 2004 a new Ambulance station was put in place in Virginia, County Cavan. Independently of this action by the North Eastern HSE our research demonstrates that Virginia represented an optimum location for a new station, this point is expanded in section 2.2 below.

In addition to standard Emergency Medical Technician (EMT) services, Advanced Paramedic (AP) services are modelled from a number of locations in the study. Other similar studies assumed that Ambulance personnel undertook minimal medical procedures and the focus of the studies was on times taken to get patients to hospital. As AP services are specifically focused on undertaking procedures to stabilise patients with life threatening conditions the focus in this study is on 'Intervention' time i.e. the time elapsed between receipt of the emergency call and arrival at scene.

Table 1

HSE Ambulance Station and cover

Area	Station	COUNTY	Cover (Jan. 2005)
NE	Cavan	Cavan	24-Hour 'On-Duty'
NE	Ardee	Louth	24-Hour 'On-Duty'
NE	Drogheda	Louth	24-Hour 'On-Duty'
NE	Dundalk	Louth	24-Hour 'On-Duty'
NE	Dunshaughlin	Meath	24-Hour 'On-Duty'
NE	Navan	Meath	24-Hour 'On-Duty'
NE	Monaghan	Monaghan	24-Hour 'On-Duty'
NE	Virgina	Cavan	24-Hour 'On-Duty'

[1] Opened December 17th 2004.

A number of models are presented below that encompass a variety of configurations of services; the targets times for these are 25-minutes for 'Response' time and 60-minutes for 'Return-to-hospital' and 'Intervention' time.

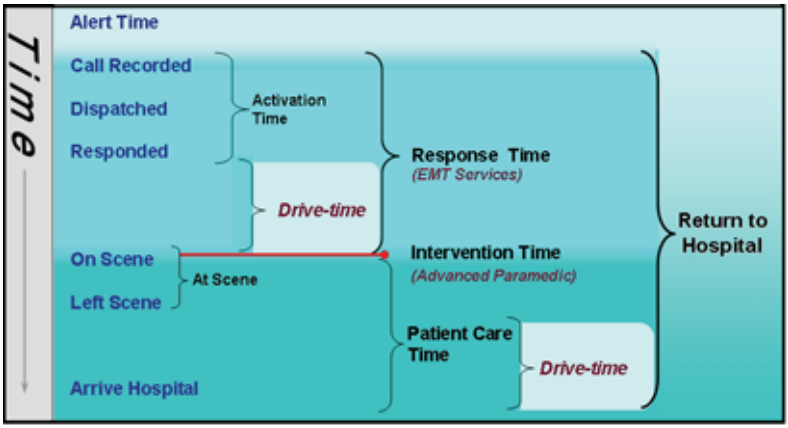
[1] The authors use the term 'Spatial Cover' to differentiate between it and the term 'Ambulance Cover' which relates to hours of availability and staffing arrangements at individual stations.

1.2 Critical Time Elements

The assessment of Response time, Return-to-hospital time and Intervention time are based on a number of separate activities in the delivery of care, these are;

Alert Time	*The time from the moment of the accident to the call to emergency services.*
Response Time	*The time from receipt of the call to arrival at the scene. Includes activation and drive time.*
Return to Hospital Time	*The sum of Response time and the time from arrival at 'Scene' to arrival at an appropriate hospital. Includes Patient care and return drive-time.*
Intervention Time	*The time from receipt of call to arrival at the scene of an Advanced Paramedic team.*

Figure 1.1 *Critical Time Elements*



'Alert' time, is the time between an emergency incident occurring and notification of the emergency services. It is difficult to estimate and varies according to context, however, it is assumed here that this time interval has reduced considerably in recent years due to the prevalence of mobile phones and is likely in many instances to be less than a minute.

Response time has been shown to have a wide range in Ireland (Breen et al, 2000)[2]. Key factors that influence response time include crew availability, distances and travel conditions.

Crew availability primarily affects 'Activation time' and with the widespread use of 24 hour cover in most Ambulance stations it is assumed that average activation times have reduced. We assume an activation time of 5-minutes which reflects the median activation time for 'on-duty' crews found by Breen. From this figure a nominal target of 25 minutes 'Response time' is used in the study made up of 5 minutes activation time and 20 minutes drive-time.

Patient care time will vary considerably according to the nature of the incident, and will thereby influence the 'Return-to-hospital' time. To simplify matters a five-minute stay is assumed at the incident and a slightly slower driver time to bring the patient to the required hospital. On this basis a nominal target of 60 minutes 'Return-to-hospital' time is chosen.

It is important to stress that the nominal targets do not represent definitive quality targets for Ambulance services but are instead intended to provide broad standardised objectives that can be used to compare the spatial cover between stations and regions only in the context of this study.

[2] Breen N, Wood J, Bury G, Murphy AW, Brazier H (2000). 'A national census of ambulance response times to emergency calls in Ireland'. Journal of Accident and Emergency Medicine, 2000, 17: 392-5.

1.3 GIS Analysis

A GIS drive-time model is used to estimate the relevant spatial distances from each Ambulance station. The model uses road distance travelled and road quality. A delay factor has been applied for urban areas, where other road users are likely to delay progress of Ambulances. The average road speeds for Ambulances that have been used in the study are listed below. Although these vary according to the time of day and day of the week a standard delay factor has been applied which maintains the relative clarity of the model. The times used in the model are listed below in Table 2.

The first part of the model produces drive-time distances for each Ambulance station. These then are combined with return drive times for the study area back to specified hospital locations. The model assumes that each accident/incident will be served by the closest Ambulance station (by time) and that the Ambulance will return to the nearest appropriate secondary care centre. The model is flexible and different Ambulance station and hospital configurations can be used to test optimum service patterns.

Table 2

Average Road Speeds used in Model

	Average		Kilometres
Road Type	**MPH**	**KMH**	**Per Minute**
Motorway	68	109.4	1.82
National Primary	60	96.5	1.61
National Secondary	50	80.5	1.34
Regional Road	48	77.2	1.29
Third Class	32	51.5	0.86
Fourth Class	25	40.2	0.67
Northern Ireland (B) Road	50	80.5	1.34
Urban Normal Road	35	56.3	0.94
Urban Slow (Congested areas)	20	32.2	0.54

The drive-times used have been assessed by Ambulance personnel in the region and have been found to be broadly accurate with actual drive-times of Ambulances. However it must be stressed that these drive times represent an average approximation under controlled circumstances and assumptions in respect of different types of Ambulance times.

Estimation of population within the specified targets is carried out through 'overlaying' the GIS datasets of Electoral Divisions (ED)[3] with the results of the drive-time model. Invariably the results of the model and ED boundaries are not conterminous, in these cases an evaluation is made on where to assign the relevant population. The evaluation is made on the basis of the percentage of the ED within the particular drive-time distance and the local geography of the ED, which will influence the likely location of population within each ED.

For the Road Traffic Accidents a simple overlay procedure is used, and accidents for each drive-time distance allocated solely on the basis of whether it lies within a particular drive-time band.

1.3.1 Data sources

A number of datasets were utilised in the study, these are listed in Table 3. The NRA Road Traffic Accidents database was used to provide information on all road traffic accidents in

[3] Electoral Divisions are the smallest aerial unit that is published by the CSO.

each region. The NRA compiles the database from records provided by An Garda Síochána[4]. The database lists all road traffic accidents where injury or damage to vehicles occurred from 1990 to the present. The database is very comprehensive and includes information on; numbers of people and vehicles involved; the age and sex of drivers, passengers and pedestrians; types of injuries sustained by drivers, passengers and pedestrians; time and location of each incident; the road type; the weather and driving conditions and possible cause of the accident.

The location attributes of the database are very important to this study as individual accidents can be located to +/- 100 metres and this allows close analysis of the spatial patterns of the RTA's.

In the Road Traffic Accidents database injuries are classified as 'Fatal', 'Serious Injury' or 'Minor Injury'. Fatal injuries occur when at least one person is killed as a result of the accident within 30 days of the accident. Serious injury is defined as an injury for which the person is detained in hospital as an 'in patient', or has sustained any of the following injuries whether or not they were detained in hospital: fractures; concussion; internal injuries; crushing; severe cuts and lacerations; and, severe general shock requiring medical treatment. Minor injuries are an injury of a minor nature such as a sprain or bruise (NRA, 2000).

Table 3

GIS Datasets used in the Study			
Data Set	***Type***	***Source***	***Description***
Roads 1:210,000	*GIS Vector*	*OSI*	*All roads classified by NRA Road Code*
Administrative *(County) Boundaries,* 1:210,000	*GIS Vector*	*OSI*	
DED Boundaries *(*SABE*)*	*GIS Vector*	*Eurogeographics*	*Small Area Statistics administrative boundaries*
Lakes Rivers *and* ***Background mapping*** 1:210,000	*GIS Vector*	*OSI*	
Main Towns *Polygons and points* (1:210,000)	*GIS Vector*	*OSI*	
Census of Population *1996*	*Numeric*	*CSO*	*Total Population*
Census of Population *2002*	*Numeric*	*CSO*	*Total Population*
Service points *– Ambulance Stations*	*Text /Numeric*	*HSE North Eastern Area*	*Coordinates and details of emergency services, including operational data of the Ambulance Services.*

[4] These are carried out on CT68 forms for all reported accidents.

1.4 Analysis Options

We consider two aspects of the operation of emergency care provision; (1) examining options that improve 'Response times' after an Ambulance has been called and (2) examining options for improving 'Intervention time'.

(A) Response Time:

The options examined are;

i) **Model 1** Quantifies the response times from the use of existing Ambulance stations before development of the new station in Virginia.

ii) **Model 2 (Baseline)** Quantifies the response times from all currently operating stations and as such forms the baseline model for subsequent models. The inclusion of this model allows examination of the potential impact of Virginia on response times in the region. Comparison of Virginia's potential impact is also made with other locations.

iii) **Model 3** Quantifies potential contribution from use of the Ambulance stations in neighbouring HSE areas in the Republic of Ireland.

iv) **Model 4** Quantifies potential contribution from use of the Northern Ireland Ambulance Service (NIAS).

v) **Model 5 (Possible New Deployment Point)** Evaluates the impact of development of a possible new Ambulance deployment location in Ballyconnell, Co Cavan but excluding Ambulance services from Northern Ireland.

(B) Return-to-Hospital – 'Intervention Time':

Again a number of scenarios are examined:

vi) **Model 6 (Baseline Return-to-Hospital Time)** Evaluation of 'Return-to-hospital times' using existing Ambulance resources both within the region and in neighbouring regions (excluding Northern Ireland) providing standard Emergency Medical Technician (EMT) services with two hospitals (Drogheda & Cavan) providing secondary emergency care.

vii) **Model 7** Examination of the potential impact on 'Return-to-hospital times' where neighbouring hospitals from the Midlands and North Western areas and Eastern Region (Sligo, Mullingar and Beaumont Hospitals) also provide secondary emergency care, and EMT Ambulance services are provided from neighbouring regions.

viii) **Model 8** Examination of the potential impact on 'Return-to-hospital' times where both Ambulance services and secondary emergency care are provided from Enniskillen and Newry.

ix) **Model 9 (Intervention Time)** Examination of the potential impact on 'Intervention times' through the use of Advanced Paramedic (AP) services in Monaghan and Navan with both Ambulance services and secondary emergency care provision from the NE area, neighbouring regions and Northern Ireland (as per model 8).

1.5 Model Assumptions and Operational Contingencies

The fundamental assumption used in this study, that there are always Ambulance resources available at the nearest station to a particular incident is required to allow comparisons of the geographic relationship between Ambulance service provision and centres of secondary emergency care. Commonly in operational practice this assumption does not prevail and a particular station may not have resources available due to other emergency commitments or patient transport duties. In addition certain critical time elements can be considered to reflect optimum minimal times under 'best case' conditions; including for example short 'at scene' times, dry weather travel times etc.

These 'normalising' assumptions allow comparisons between different areas and enable comparisons of the geographic distribution of emergency services. To reflect real operational contingencies it is necessary to model real incidents and Ambulance responses taken from operational records. This type of analysis has relevance for the distribution and availability of Ambulance resources within any region and the relationship to areas of highest demand for those resources. As such this builds on and complements the current study by including operational contingencies in addition to the geographic patterns of service potential presented here. The Pre-Hospital Emergency Care Council is engaged in preliminary studies on methods of using actual incident records to undertake this second phase of spatial analysis of emergency care provision.

2 Response Times

2.1 Model 1 Station Provision (pre-December 2004) without service from Virginia

The response times are assessed for the seven Ambulance stations in operation before December 2004. The response times portrayed in Map 1 and the respective population and Road Traffic Accident data are provided in Tables 4 & 5 below.

Five locations are found to lie outside the 25-minute target, the largest of these forms a large swath (area 1) extending through the centre of the study area north of the town of Virginia in county Cavan to the relatively isolated areas south of a line between Cootehill to Castleblaney. Within this area 9,825 people were resident (2.8% of total population) in 2002 and 78 RTA's occurred between 1997 and 2001 (2% of total). Following this the next most significant area is found in the southern most part of the region in SW Meath where 8,214 people (2.4%) live in out-of-target areas and 68 (1.7%) occurred in the area. The out-of-target area south of Virgina (area 5) toward the Westmeath border had 7,044 people resident and 32 RTA's occurred within it.

The out-of-target area in NW Cavan had in the year 2002 just over 3,400 people resident within it and 29 RTA's occurred there. This area includes part of Cavan that is serviced by the HSE Northwest Area, and roughly 900 people of the total are based there. Total county figures are presented here to allow comparison with county population totals.

Table 4

Response-time Populations *(Model 1)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Central Block (1)	9,825	*2.8%*	9,304	*3.0%*
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	3,473	*1.0%*	3,459	*1.1%*
SW Meath (4)	8,214	*2.4%*	6,630	*2.2%*
Westmeath Border (5)	7,044	*2.0%*	6,512	*2.1%*
Outside 25 Minutes	**29,069**	*8.4%*	**26,382**	*8.6%*
Within 25 Minutes	**315,896**	*91.6%*	**279,773**	*91.4%*
Total	*344,965*	*100%*	*306,155*	*100%*

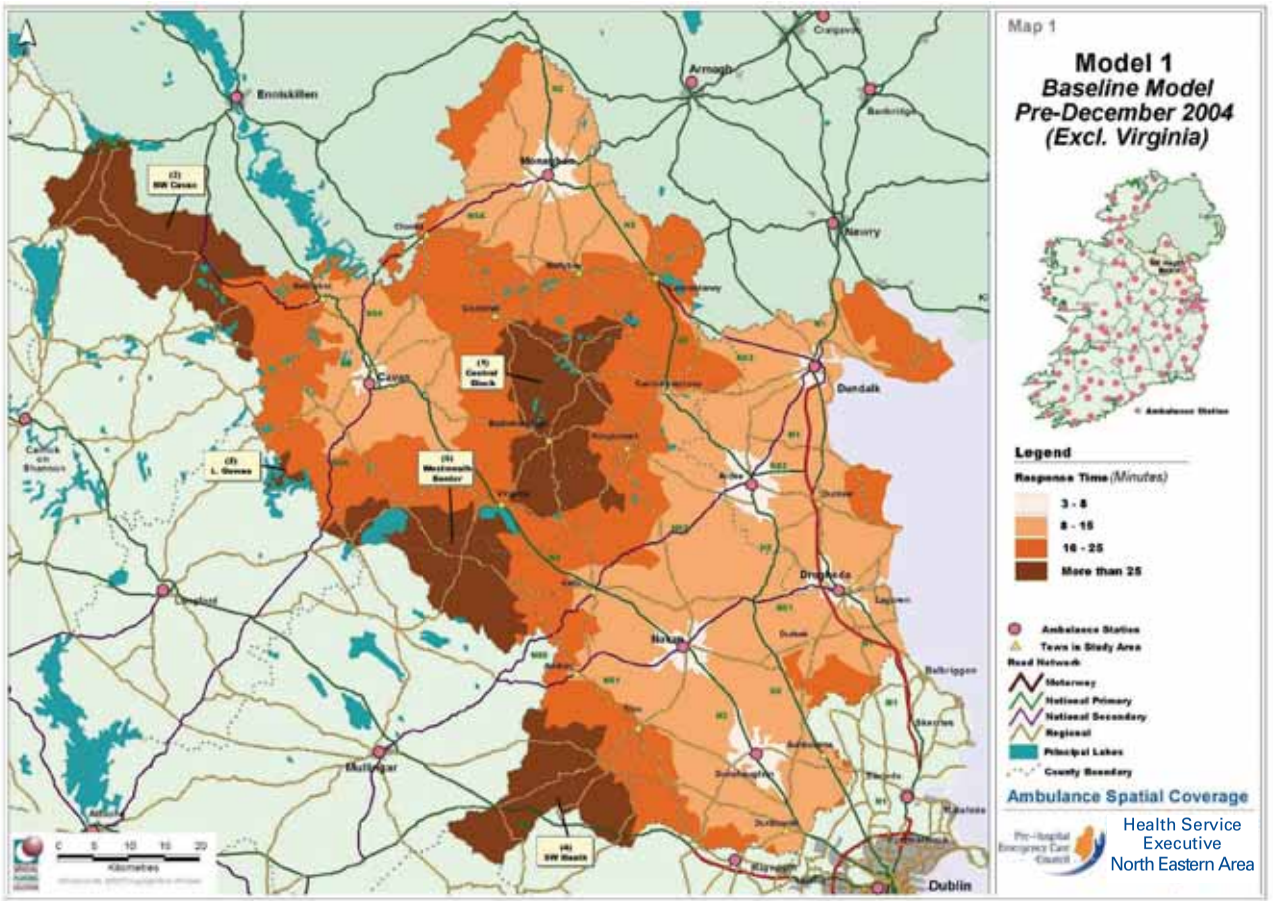
Source: CSO 2002, SPS Drive-time Model

Table 5

Response-time RTA's 1997 - 2001 *(Model 1)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	78	*2.0%*	*7*	*2.3%*	34	*3.1%*	109	*1.9%*
Lake Gowna (2)	2	*0.1%*	*0*	*0.0%*	1	*0.1%*	2	*0.0%*
NW Cavan (3)	27	*0.7%*	*1*	*0.3%*	4	*0.4%*	43	*0.8%*
SW Meath (4)	69	*1.7%*	*4*	*1.3%*	11	*1.0%*	91	*1.6%*
Westmeath Border (5)	32	*0.8%*	*3*	*1.0%*	11	*1.0%*	39	*0.7%*
Outside 25 Minutes	**208**	*5.2%*	**15**	*5.0%*	**61**	*5.6%*	**284**	*5.1%*
Within 25 Minutes	**3,761**	*94.8%*	***283***	*95.0%*	**1,027**	*94.4%*	**5,323**	*94.9%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model


Map 1
Model 1
Baseline Model
Pre-December 2004
(Excl. Virginia)
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service
Executive
North Eastern Area
Armagh
Dundalk
Navan
Drogheda
Dublin
Ballymena
Antrim
Kilometres

The final area found outside the target response time is a small area around Lough Gowna in Cavan where poor road infrastructure and the Lakeland topography result in poor spatial cover; population and RTA figures are low however.

2.2 Model 2 Station Provision (post December 2004) inclusive of service from Virginia

This model builds on the previous model and examines the impact of the new Ambulance station located in Virginia Co. Cavan. The station commenced service in December 2004 and is positioned between the out-of-response target areas identified as the 'Central Block' and 'Westmeath Border' in Model 1. Virgina is well located to address these out-of-target areas however the town of Bailieborough also is located within the two areas and in this section we briefly assess whether more people/RTA's could be reached within the response target than at Virginia.

Table 6

Response-time Populations *(Model 2)*

Location	Total Population			
	2002	*%*	*1996*	*%*
Central Block (1)	1,122	*0.3%*	1,181	*0.4%*
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	3,473	*1.0%*	3,459	*1.1%*
SW Meath (4)	8,214	*2.4%*	6,630	*2.2%*
Outside 25 Minutes	**13,322**	*3.9%*	**11,747**	*3.8%*
Within 25 Minutes	**331,643**	*96.1%*	**294,408**	*96.2%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 7

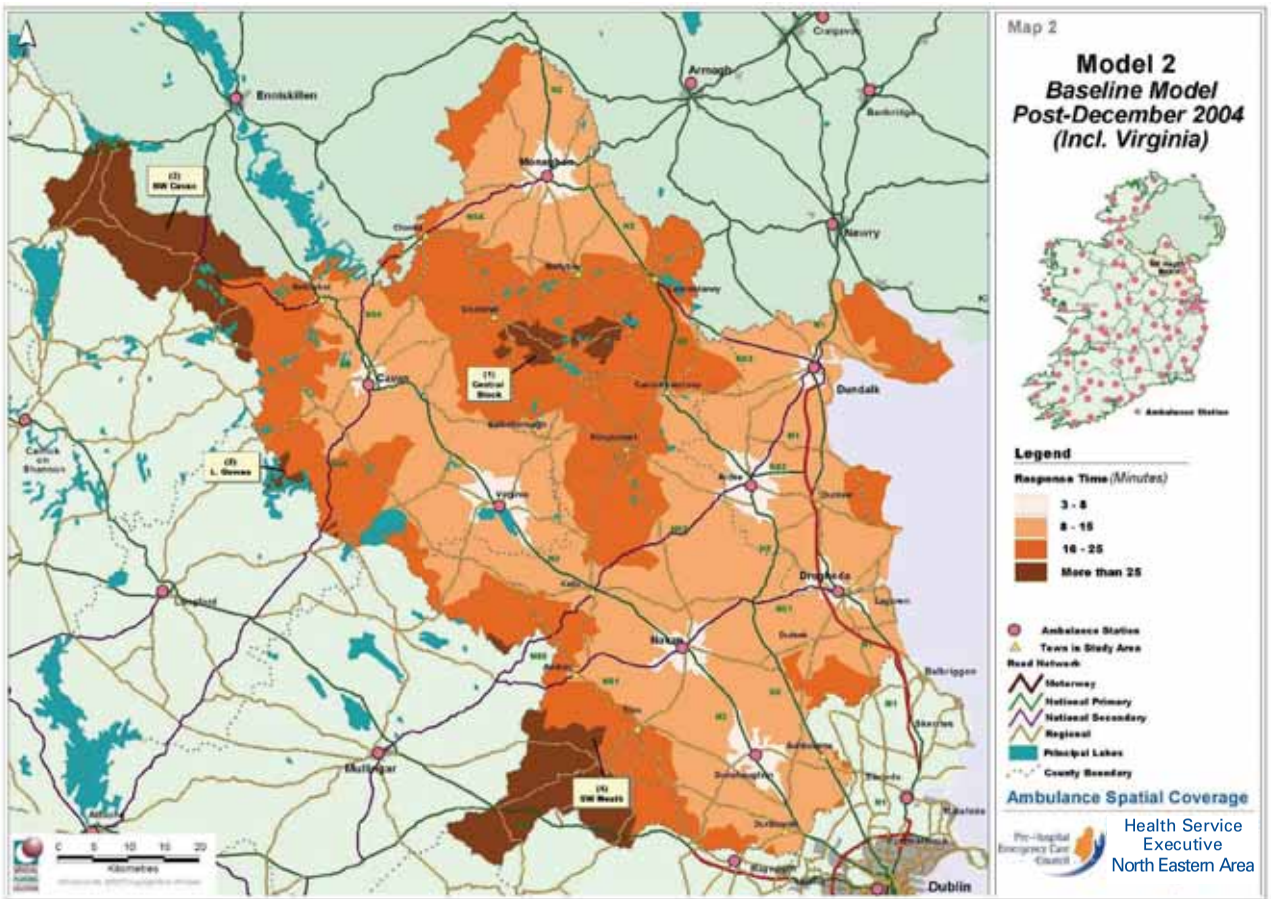
Response-time RTA's 1997 - 2001 *(Model 2)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	19	*0.5%*	*1*	*0.3%*	5	*0.5%*	30	*0.5%*
Lake Gowna (2)	2	*0.1%*	*0*	*0.0%*	1	*0.1%*	2	*0.0%*
NW Cavan (3)	27	*0.7%*	*1*	*0.3%*	4	*0.4%*	43	*0.8%*
SW Meath (4)	69	*1.7%*	*4*	*1.3%*	11	*1.0%*	91	*1.6%*
Outside 25 Minutes	**117**	*2.9%*	**6**	*2.0%*	**21**	*1.9%*	**166**	*3.0%*
Within 25 Minutes	**3,852**	*97.1%*	***292***	*98.0%*	**1,067**	*98.1%*	**5,441**	*97.0%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model

The response times for this configuration are presented in Map 2, and it is apparent that effectively all of the area identified as 'Westmeath Border' and considerable areas in the 'Central Block' that were out of the response target in the previous model are now within the 25-minute target. There remains only a narrow band that is beyond the 25-minute target running approximately East-West just south of Cootehill. In total there are 1,122 people living in this area and 19 RTA's (with one fatality) occurred there (see Tables 6 & 7).

The impact of the provision of additional services in Virgina is apparent from the population and RTA figures where an overall reduction of 54% of people living outside the target area (44% reduction in numbers of RTA's) is indicated between model 1 and model 2.


Map 2
Model 2
Baseline Model
Post-December 2004
(Incl. Virginia)
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Eastern Area
Kilometres
Armagh
Enniskillen
Cavan
Dundalk
Navan
Drogheda
Dublin
Monaghan
Virginia

When a model is run with a new station located in Bailieborough, a village approximately 14 kilometres north of Virgina we find that a linear strip running along the Meath/Westmeath border could not be reached within the 25-minute target. Within this area 3,477 people were resident in 2002 and 24 RTA's occurred. Therefore in the context of our model Virginia is the optimum location within the central area to locate a new station/deployment point. Furthermore Virginia is likely to have better logistical advantages as a deployment point than Bailieborough through being located on the N3 (Dublin Cavan Road) and thus able to draw on any surplus resources from Ambulance stations in Cavan or Navan if required.

2.3 Model 3 Use of Neighbouring Stations

In an earlier study that examined the distribution of Ambulance services in the North Eastern HSE area the methodology excluded the use of Ambulance resources from neighbouring HSE areas. This aspect of the methodology facilitates clarity of the response capability of Ambulance services within each separate HSE area. Furthermore since the use of neighbouring services is often on an 'ad-hoc' basis with decision on utilisation undertaken on a case-by-case basis it is difficult to fully quantify the extent of cross regional services. The neighbouring Ambulance stations that are examined in Model 3 are listed below in Table 8. The model again assumes 24/7 'on-duty' cover and that each station has resources available at all times.

Table 8

Neighbouring Ambulance Station to MWHB		
Station	**HSE Area**	**Service Cover**
Manorhamilton	North Western	24 Hour / 7 Day 'On-Duty'
Longford	Midlands	24 Hour / 7 Day 'On-Duty'
Mullingar	Midlands	24 Hour / 7 Day 'On-Duty'
Maynooth	Eastern	24 Hour / 7 Day 'On-Duty'

The impact from the use of neighbouring Ambulance stations from surrounding HSE areas is presented in Tables 9 and 10 below and portrayed in Map 3. The significant reduction in both population and RTA's found to be outside the target occurs because Mullingar and Maynooth Ambulance services effectively eliminate areas outside the response target in SW Meath.

Table 9

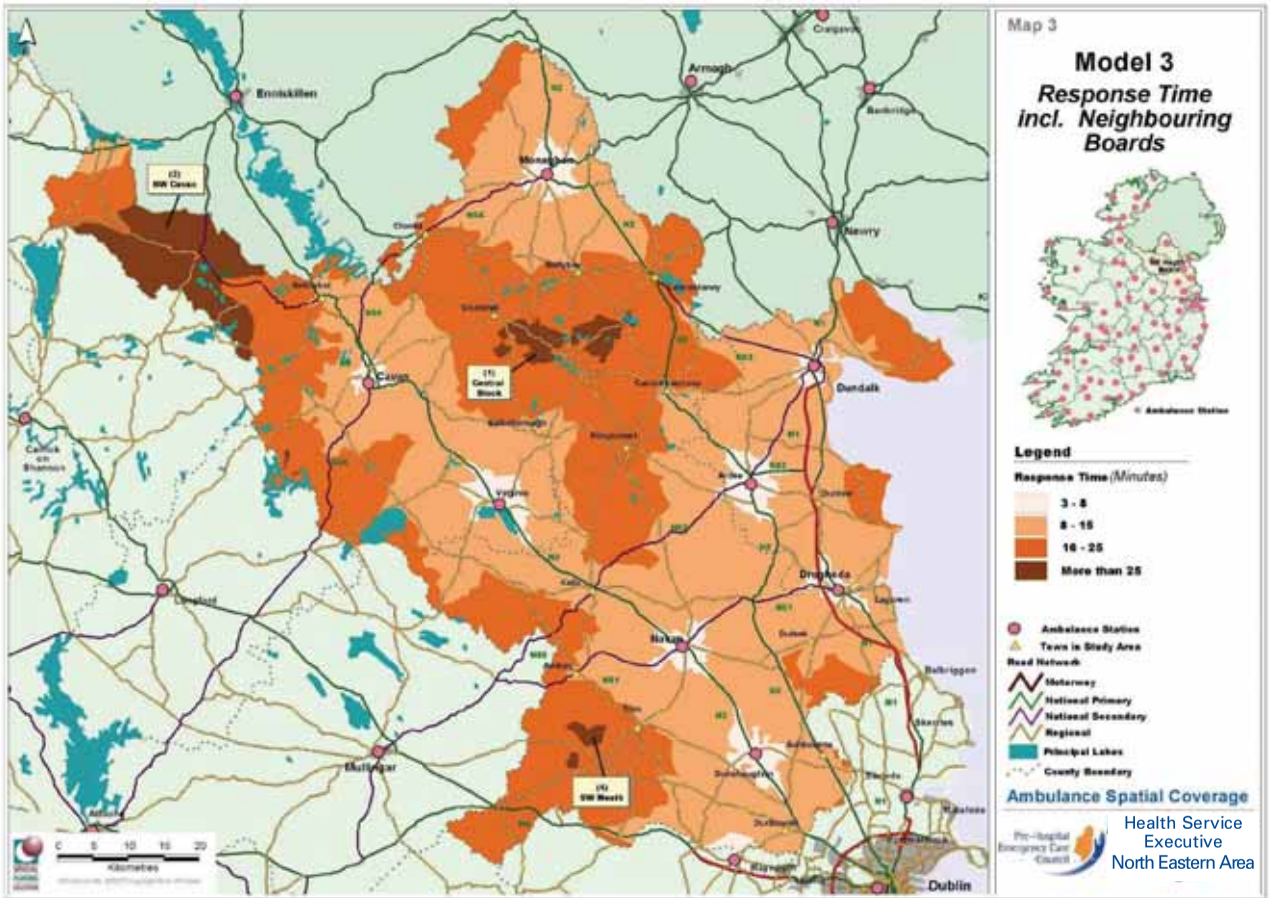
Response-time Populations *(Model 3)*				
Location	**Total Population**			
	2002	***%***	***1996***	***%***
Central Block (1)	1,122	*0.3%*	1,181	*0.4%*
NW Cavan (3)	2,536	*0.7%*	2,465	*0.8%*
Outside 25 Minutes	**3,658**	*1.1%*	**3,646**	*1.2%*
Within 25 Minutes	**341,307**	*98.9%*	**302,509**	*98.8%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 10

Response-time RTA's 1997 - 2001 *(Model 3)*								
Location	**RTA's**		**Fatal Injuries**		**Serious Inj.**		**Minor Inj.**	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	19	*0.5%*	*1*	*0.3%*	5	*0.5%*	30	*0.5%*
NW Cavan (3)	18	*0.5%*	*1*	*0.3%*	4	*0.4%*	27	*0.5%*
Outside 25 Minutes	**37**	*0.9%*	**2**	*0.7%*	**9**	*0.8%*	**57**	*1.0%*
Within 25 Minutes	**3,932**	*99.1%*	***296***	*99.3%*	**1,079**	*99.2%*	**5,550**	*99.0%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model


Map 3
Model 3
Response Time incl. Neighbouring Boards
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive North Eastern Area
Armagh
Enniskillen
Navan
Dundalk
Cavan
Drogheda
Dublin
Monaghan
Kilometres

Services from Longford can reach the Lough Gowna area in less than 25-minutes in this model and Ambulance services from Manorhamilton can reach parts of NW Cavan within the target time. The total number of people resident outside the target using the assumptions in this model is 3,658 and 37 RTA's, around 1% of the total for each.

The reduction of people outside the target from the baseline model 2 is 9,664 people or a 73% reduction. The majority of reduction in out-of-target areas is shared more or less equally between Mullingar and Maynooth.

2.4 Model 4 Use of Ambulance Stations in Northern Ireland

Ambulance stations located at Enniskillen, Armagh and Newry are tested in this model to establish the degree which services from the Northern Ireland Ambulance Service (NIAS) can address areas outside the 25-minute response target. The model assumes that all NE area stations provide cover as do the neighbouring stations in adjacent HSE areas as per model 3.

Table 11

Response-time Populations *(Model 4)*

Location	Total Population			
	2002	*%*	*1996*	*%*
Central Block (1)	1,122	*0.3%*	1,181	*0.4%*
NW Cavan (3)	1,016	*0.3%*	989	*0.3%*
Outside 25 Minutes	**2,138**	*0.6%*	**2,170**	*0.7%*
Within 25 Minutes	**342,827**	*99.4%*	**303,985**	*99.3%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

Under this model a total of 2,138 people (0.6% of total population) live in areas beyond the 25-minute response target. A similar percentage of the total number of RTA's that occurred in the region between 1997 and 2001 were found in areas outside the target (0.6%).

Although use of Ambulance services from Newry and Armagh reduces the overall drive-times for areas in the NE area close to the border, in particular north of Dundalk in the Colley Mountains (i.e. benefits from services from Newry), the only impact on target response times occurs in NW Cavan (see Map4).

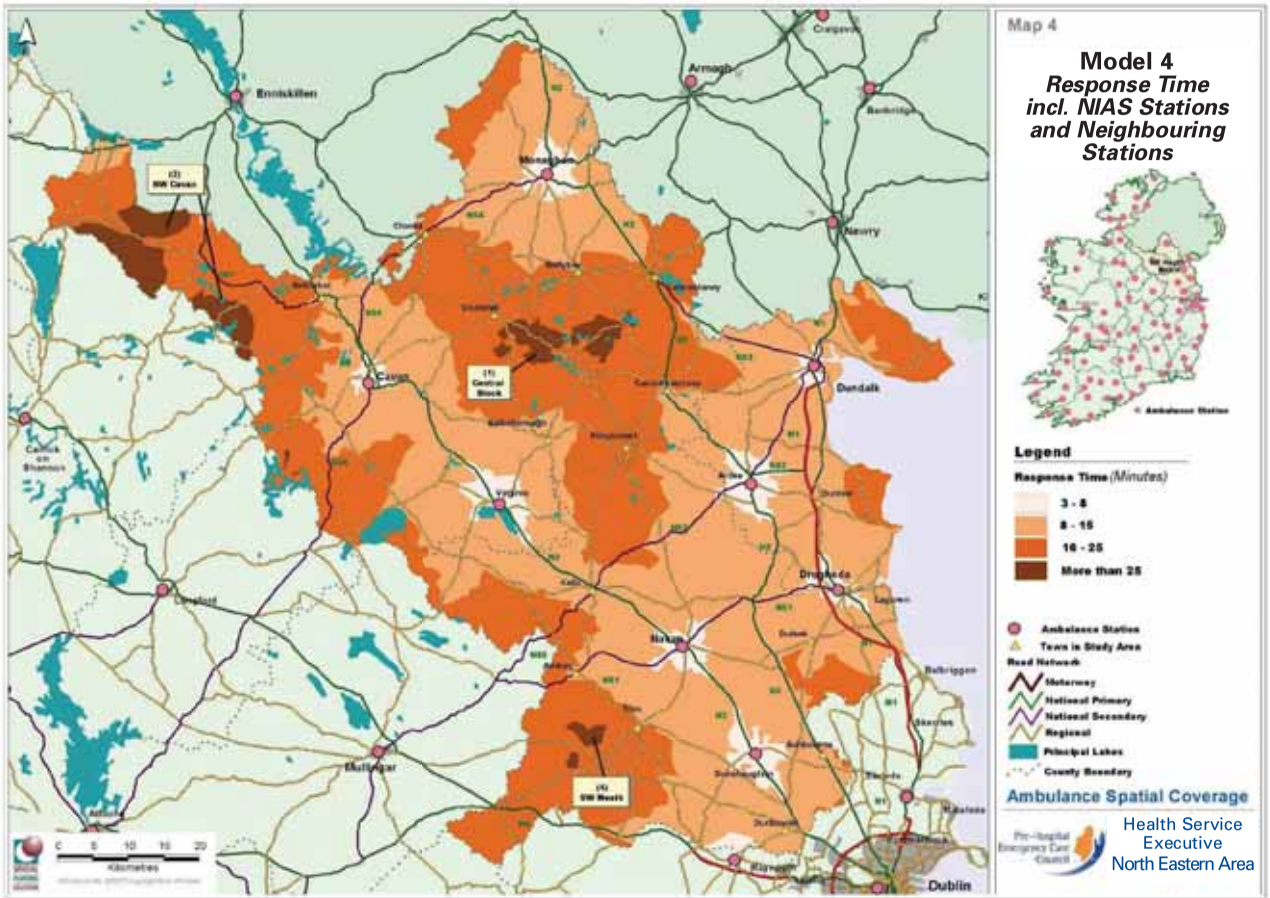
In terms of population the numbers of people resident in out-of-target areas in the NW Cavan reduces from 2,536 when only neighbouring HSE areas provide services to 1,016 when NIAS provide services from Enniskillen. No change occurred in the Central Block in respect to population or RTA's between model 3 and 4. (see Tables 11 & 12)

Table 12

Response-time RTA's 1997 - 2001 *(Model 4)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	19	*0.5%*	*1*	*0.3%*	5	*0.5%*	30	*0.5%*
NW Cavan (3)	6	*0.2%*	*0*	*0.0%*	4	*0.4%*	10	*0.2%*
Outside 25 Minutes	**25**	*0.6%*	**1**	*0.3%*	**9**	*0.8%*	**40**	*0.7%*
Within 25 Minutes	**3,944**	*99.4%*	**297**	*99.7%*	**1,079**	*99.2%*	**5,567**	*99.3%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model


Map 4
Model 4
Response Time
incl. NIAS Stations
and Neighbouring
Stations
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service
Executive
North Eastern Area
Enniskillen
Armagh
Newry
Dundalk
Cavan
Drogheda
Navan
Dublin
Monaghan
Kilometres

2.5 Model 5 New Deployment Location, Ballyconnell, Co. Cavan

This model assesses the potential impact of the development of a new Ambulance deployment point in Ballyconnell Co. Cavan. Results from model 3 indicated that the principal out of target areas that occur using all NE area Ambulance stations together with neighbouring stations occurred in NW Cavan. This isolated area has poor road infrastructure and despite a low population density throughout the area, there was 2,536 people resident in the out-of-target area. This model does not include Ambulance stations in Northern Ireland and therefore allows evaluation and comparison between provision locally within the NE area and that provided from across the border.

Map 5 indicates that with the addition of a new deployment point in Ballyconnell the majority of the population in the area, and all the locations where RTA's occurred can be reached within the target time. The residual out-of-target area in NW Cavan is principally located in the uplands on either side of the Ballyconnell/Manorhamilton road, in areas of very low population. In total 172 people were estimated to remain out-of-target and no accidents were recorded for the area (see Table 13 & 14).

1,016 people were located in out-of-target areas with the use of the Northern Ireland Ambulance Service. Thus an additional 844 people (0.2% of total population) would benefit in terms of the target response times were an Ambulance deployment point developed in Ballyconnell when services were also provided from Northern Ireland. Under these conditions the case for an additional deployment point in Ballyconnell is weak. The low population numbers and dispersed nature of settlement in the area suggests that a managed Community Responder Scheme may have a strong role to play in this part of the North East.

Table 13

Response-time Populations *(Model 5)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Central Block (1)	1,122	*0.3%*	1,181	*0.4%*
NW Cavan (3)	172	*0.0%*	139	*0.0%*
Outside 25 Minutes	**1,294**	*0.4%*	**1,320**	*0.4%*
Within 25 Minutes	**343,671**	*99.6%*	**304,835**	*99.6%*
Total	*344,965*	*100%*	*306,155*	*100%*

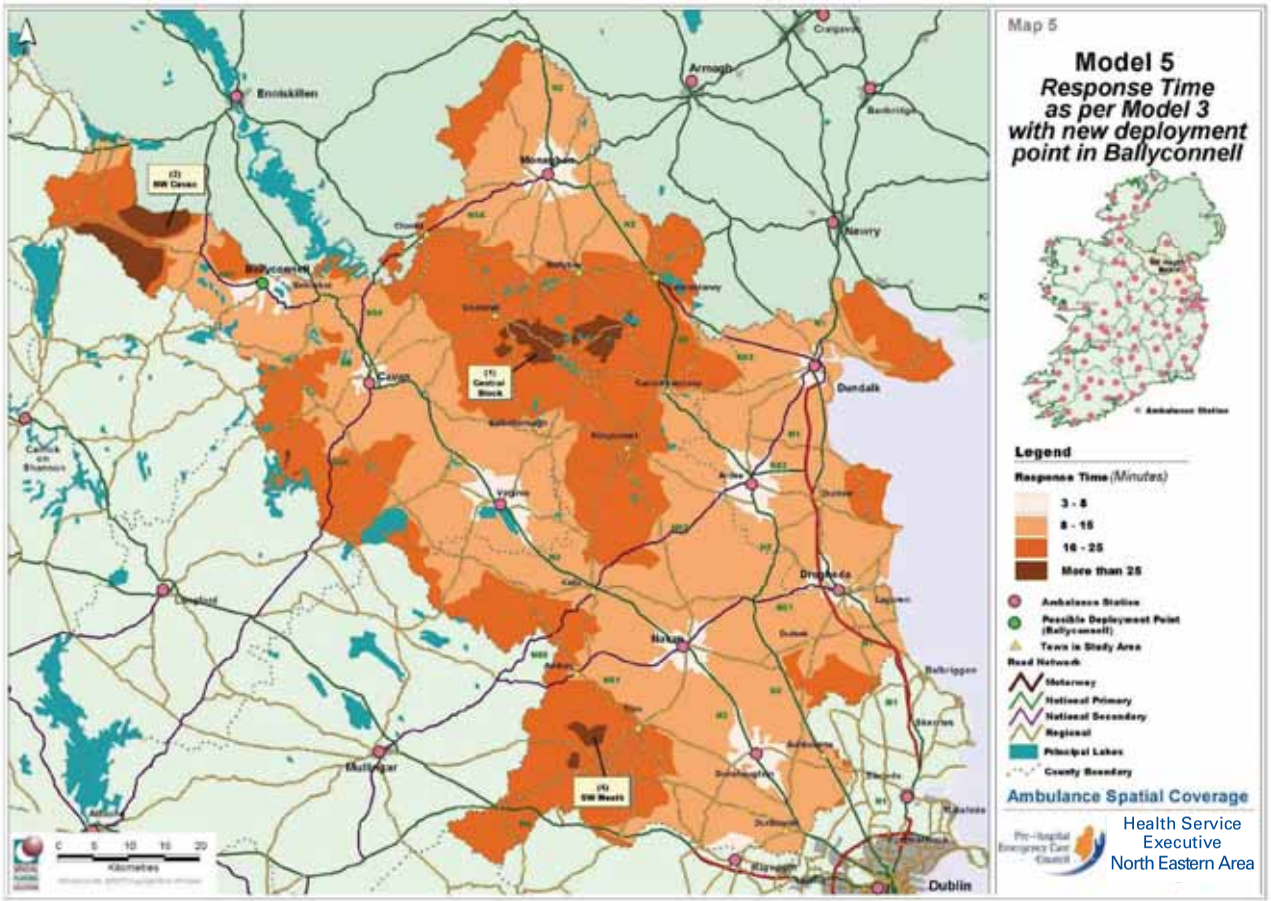
Source: CSO 2002, SPS Drive-time Model

Table 14

Response-time RTA's 1997 - 2001 *(Model 5)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	19	*0.5%*	*1*	*0.3%*	5	*0.5%*	30	*0.5%*
NW Cavan (3)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
Outside 25 Minutes	**19**	*0.5%*	**1**	*0.3%*	**5**	*0.5%*	**30**	*0.5%*
Within 25 Minutes	**3,950**	*99.5%*	**297**	*99.7%*	**1,083**	*99.5%*	**5,577**	*99.5%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model


Map 5
Model 5
Response Time as per Model 3 with new deployment point in Ballyconnell
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Ambulance Station
Possible Deployment Point (Ballyconnell)
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Eastern Area
Enniskillen
Armagh
Newry
Dundalk
Drogheda
Navan
Cavan
Monaghan
Ballyconnell
Longford
Mullingar
Ashbourne
Dublin
Kilometres

2.6 Response Time Findings

The location of the new Ambulance station in Virgina had a very positive impact on target response times for the region with a reduction of 15,747 people (54%) outside the 25-minute response target in model 2.

In comparison with other HSE regions the North Eastern Area had the sixth highest population located in areas beyond the 25-minute target when only Ambulance services within the region are utilised, only the Southern and Eastern areas had lower out-of-target populations.

Table 15 **National Results of Baseline Response Model**

(No cross regional services modelled)

Outside 25-minute Response-time, *(Population)*			
HSE Area	**Population** ***2002***	**Region** ***%***	**National** ***%***
Western	56,784	14.9%	*1.45%*
North Eastern	13,322	3.9%	*0.34%*
South Eastern	17,808	4.2%	*0.45%*
Eastern	8,121	0.6%	*0.21%*
North Western	22,401	10.1%	*0.57%*
Southern	4,923	0.8%	*0.13%*
Midlands	28,775	12.8%	*0.73%*
Mid-Western	15,041	4.5%	*0.38%*
Outside 25 Min. ***(000's)***	**167.2**	4.3%	***4.3%***
Within 25 Min. ***(000's)***	**3,746.4**	95.7%	***95.7%***
National Total (000's)	*3,913.6*	*100%*	*100%*

Source: CSO 2002, SPS Drive-time Model

Considerable reduction of out-of-target areas occurred through the use of neighbouring Ambulance stations in other HSE areas and from Northern Ireland (NIAS). Under these conditions just 2,138 people (0.6% of regional population) were resident in areas beyond the 25-minute target. The use of an additional deployment point in Ballyconnell in model 5, demonstrated only marginal enhancement of Ambulance service, particularly if services from Northern Ireland are available.

3 Return-to-Hospital & Intervention Time

3.1 Model 6 Baseline 'Return to Hospital'

For the purposes of this study we assume that secondary emergency care centres are based in two locations within the North Eastern area, Drogheda and Cavan. Limiting the study to these centres facilitates analysis of the impact of reduced emergency care provision in Monaghan Hospital. The exclusion of Monaghan is not intended to imply any policy recommendations regarding the future service provision from the hospital but merely to allow assessment of possible patterns of care provision.

The model results presented below (see Tables 16 &17 and Map 6) include the new Ambulance service provided from Virginia which as demonstrated in the response time models had a significant impact on the numbers of people and RTA's that could be reached within the target time. In Map 6 it is clear that significant parts of the region lie outside the 60-minute target for Return-to-hospital/Intervention time. These have been divided into seven areas and within these there are 72,956 residents and 669 RTA's occurred, which represent 21% of the regions population and 16.9% of the RTA's that were recorded between 1997 and 2001 (see Tables 16 & 17). The 'N. Monaghan' area and 'Central Block' area have been split using the Monaghan/Armagh road as the dividing line. In the south the out-of-target areas identified as 'SW Meath' and the 'Westmeath Border' are split using the N52 road as the dividing line.

The most populous areas are the 'Central Block' and 'SW Meath' with 9.2% and 6.8% of the regions population respectively (31,659 and 23,482 people). Other out-of-target areas have between 3,000 to 6,000 people resident excepting the small area around Lough Gowna where 513 people were resident in 2002.

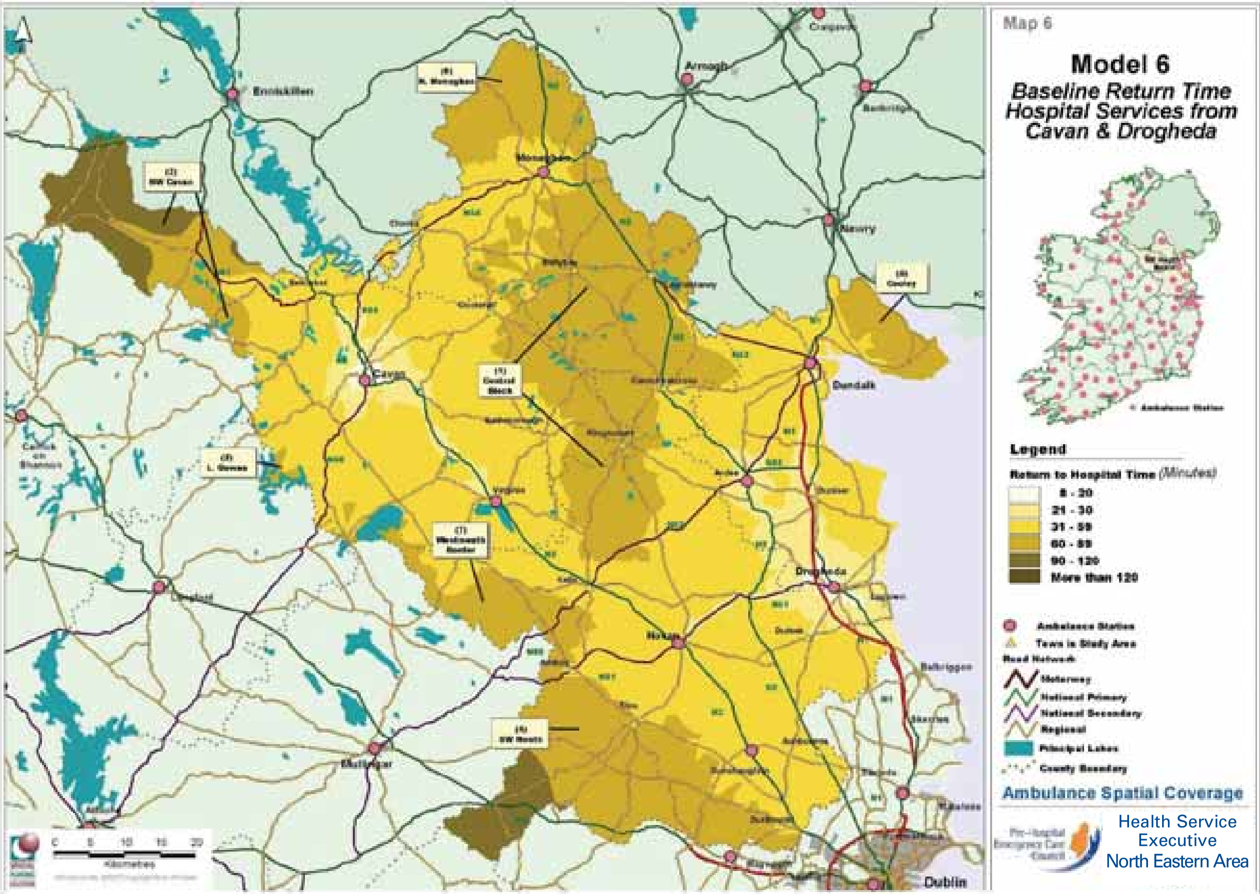
Table 16

Return-time Populations *(Baseline Model 6)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Central Block (1)	31,659	*9.2%*	29,501	*9.6%*
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	3,473	*1.0%*	3,459	*1.1%*
SW Meath (4)	23,482	*6.8%*	16,420	*5.4%*
Cooley (5)	4,298	*1.2%*	4,107	*1.3%*
N. Monaghan (6)	5,860	*1.7%*	5,645	*1.8%*
Westmeath Border (7)	3,311	*1.0%*	3,255	*1.1%*
Outside 60 Minutes	**72,596**	*21.0%*	**62,864**	*20.5%*
Within 60 Minutes	**272,369**	*79.0%*	**243,291**	*79.5%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

There was a significant increase in the out-of-target population in 'SW Meath' between the years 1996 to 2002, where an additional 7,042 people (representing an increase of 43%) were resident. This area has undergone very strong population growth in recent years due to the relatively short commuting distance to Dublin and has proved popular for young families. Strong population growth is set to continue in this area presenting increased demand for emergency care both from increased numbers of residents and high levels of commuting which impacts on the numbers of RTA's likely to occur in the area.



Map 6
Model 6
Baseline Return Time Hospital Services from Cavan & Drogheda
Legend
Return to Hospital Time (Minutes)
8 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Pre-Hospital Emergency Care Council
Health Service Executive North Eastern Area
Enniskillen
Armagh
Newry
Monaghan
Cavan
Dundalk
Drogheda
Navan
Mullingar
Dublin
Kilometres

Table 17

Return-to-Hospital RTA's 1997 - 2001 ***(Baseline Model 6)***

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	341	*8.6%*	*31*	*10.4%*	126	*11.6%*	426	*7.6%*
Lake Gowna (2)	2	*0.1%*	*0*	*0.0%*	1	*0.1%*	2	*0.0%*
NW Cavan (3)	27	*0.7%*	*1*	*0.3%*	4	*0.4%*	43	*0.8%*
SW Meath (4)	171	*4.3%*	*7*	*2.3%*	47	*4.3%*	245	*4.4%*
Cooley (5)	53	*1.3%*	*2*	*0.7%*	4	*0.4%*	86	*1.5%*
N. Monaghan (6)	55	*1.4%*	*8*	*2.7%*	13	*1.2%*	75	*1.3%*
Westmeath Border (7)	20	*0.5%*	*1*	*0.3%*	15	*1.4%*	21	*0.4%*
Outside 60 Minutes	**669**	*16.9%*	**50**	*16.8%*	**210**	*19.3%*	**898**	*16.0%*
Within 60 Minutes	**3,300**	*83.1%*	***248***	*83.2%*	**878**	*80.7%*	**4,709**	*84.0%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model

A notable feature of the RTA figures for the region are the relatively high numbers of fatalities occurring within the 'Central Block' area, where 31 fatalities were recorded during the period 1997 to 2001, this represents one fatality for every eleven RTA's. For the region as a whole there was one fatality for every 13.3 RTA's and for other out-of-target areas the number rises to between 20 and 27 RTA's per fatality. The implication of this for the emergency services is that when RTA's occur within this area, they tend to have more serious injuries than other out-of-target areas.

3.2 Model 7 Neighbouring Stations & Hospital Services

In this model Ambulance services and secondary emergency care services from neighbouring HSE areas are introduced and their impact on the out-of-target areas is assessed. The model utilises the response times as identified in model 3. Three secondary emergency care centres that impact on the 60-minute target are identified; Beaumont in the Eastern Region, Mullingar in the Midlands and Sligo in the North West.

As may be expected the principal impact of the use of neighbouring services occurs around the southern border of the study area. Overall there is a reduction of 19.1% of population and 20.2% of RTA's within out-of-target areas (13,893 people and 135 RTA's). The principal reductions occur in the 'SW Meath' area (11,066 people) and the 'Westmeath Border' area (2,219 people). A reduction in out-of-target area also occurs in the 'NW Cavan' area, this is relatively modest with only a small part of the area capable of being serviced within the target time from Sligo.

Table 18

Return-time Populations *(Model 7)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Central Block (1)	31,659	*9.2%*	29,501	*9.6%*
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	2,865	*0.8%*	2,852	*0.9%*
SW Meath (4)	12,416	*3.6%*	6,622	*2.2%*
Cooley (5)	4,298	*1.2%*	4,107	*1.3%*
N. Monaghan (6)	5,860	*1.7%*	5,645	*1.8%*
Westmeath Border (7)	1,092	*0.3%*	1,099	*0.4%*
Outside 60 Minutes	**58,703**	*17.0%*	**50,303**	*16.4%*
Within 60 Minutes	**286,262**	*83.0%*	**255,852**	*83.6%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

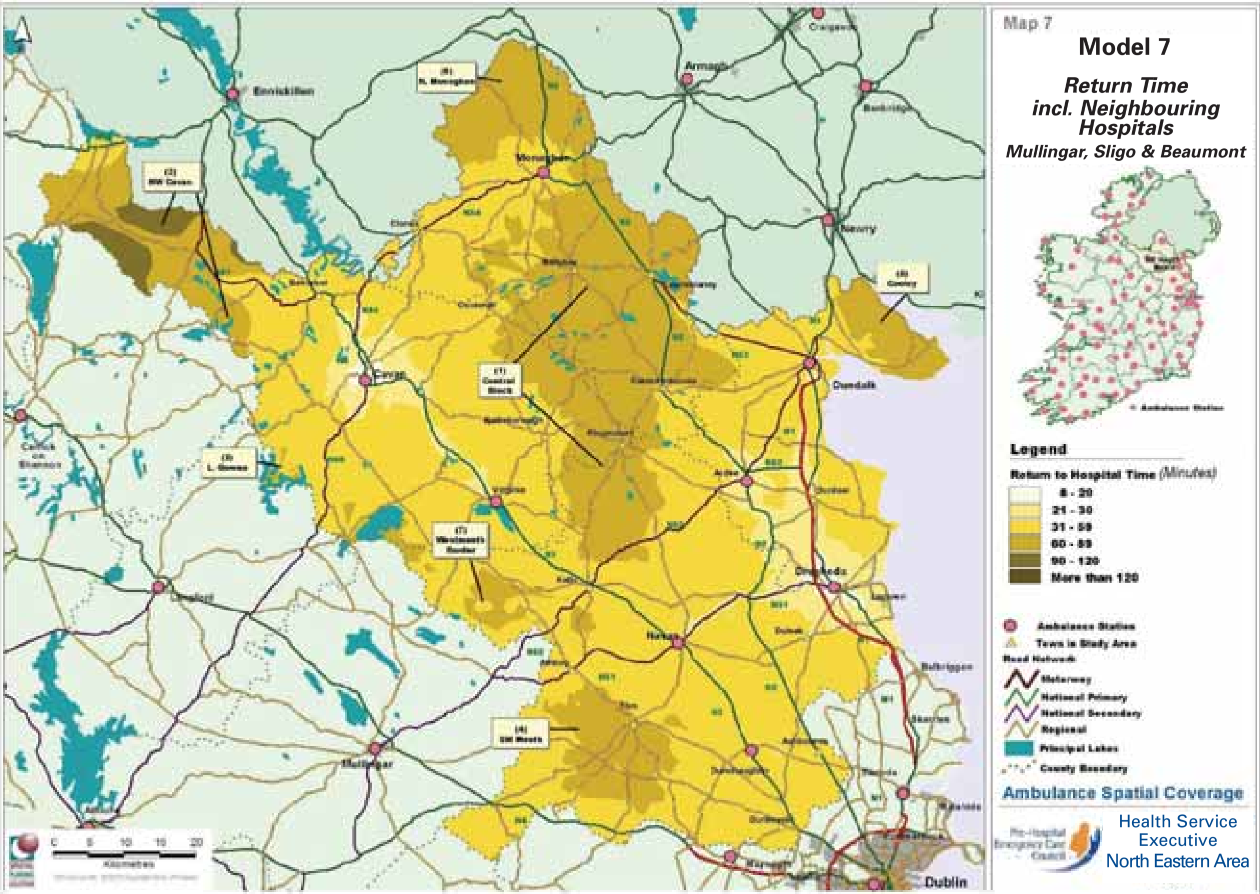
Table 19

Return-to-Hospital RTA's 1997 - 2001 *(Model 7)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	341	*8.6%*	*31*	*10.4%*	126	*11.6%*	426	*7.6%*
Lake Gowna (2)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
NW Cavan (3)	21	*0.5%*	*1*	*0.3%*	4	*0.4%*	35	*0.6%*
SW Meath (4)	58	*1.5%*	*0*	*0.0%*	16	*1.5%*	88	*1.6%*
Cooley (5)	53	*1.3%*	*2*	*0.7%*	4	*0.4%*	86	*1.5%*
N. Monaghan (6)	55	*1.4%*	*8*	*2.7%*	13	*1.2%*	75	*1.3%*
Westmeath Border (7)	6	*0.2%*	*1*	*0.3%*	0	*0.0%*	7	*0.1%*
Outside 60 Minutes	**534**	*13.5%*	**43**	*14.4%*	**163**	*15.0%*	**717**	*12.8%*
Within 60 Minutes	**3,435**	*86.5%*	***255***	*85.6%*	**925**	*85.0%*	**4,890**	*87.2%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model

No impact on the more northerly out-of-target areas occurs within the context of this model, with population and RTA figure remaining the same as per model 6 for the 'Central Block', 'Lough Gowna', 'Cooley' and 'N. Monaghan'. The increase in population in the 'SW Meath' area between 1996 and 2002 (47%) is again worth noting.



Map 7
Model 7
Return Time
incl. Neighbouring Hospitals
Mullingar, Sligo & Beaumont
Legend
Return to Hospital Time (Minutes)
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Ambulance Stations
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service
Executive
North Eastern Area
Enniskillen
Armagh
Monaghan
Newry
Dundalk
Cavan
Drogheda
Navan
Mullingar
Dublin
Kilometres

3.3 Model 8 Ambulance and Hospital services from Northern Ireland

Model 8 builds on the service patterns in model 7 by examining the use of both Ambulance and secondary emergency care services from Northern Ireland. The Response model used is the same as that in Model 4 where Ambulance services from Enniskillen, Armagh and Newry are included. Secondary emergency centres found to have an impact on target times are Enniskillen and Newry hospitals.

The use of emergency care services from Northern Ireland impacts considerably on out-of-target areas in the northern parts of the study area with significant reductions in areas beyond the 60-minute target in the 'Central Block', 'NW Cavan', 'Cooley' and 'N. Monaghan' (see Map 8). The overall population outside a 60 minute 'return-to-hospital' time is estimated to be 37,292 people representing a 51.4% reduction from the baseline model (model 6). The number of RTA's recorded as occurring in out-of-target areas also reduces by a similar scale with 266 RTA's occurring in remaining out-of-target areas (reduction of 60.2% from baseline model).

Table 20

Return-time Populations *(Model 8)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Central Block (1)	19,264	*5.6%*	18,483	*6.0%*
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	918	*0.3%*	881	*0.3%*
SW Meath (4)	12,416	*3.6%*	6,622	*2.2%*
N. Monaghan (6)	3,089	*0.9%*	3,058	*1.0%*
Westmeath Border (7)	1,092	*0.3%*	1,099	*0.4%*
Outside 60 Minutes	**37,292**	*10.8%*	**30,620**	*10.0%*
Within 60 Minutes	**307,673**	*89.2%*	**275,535**	*90.0%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 21

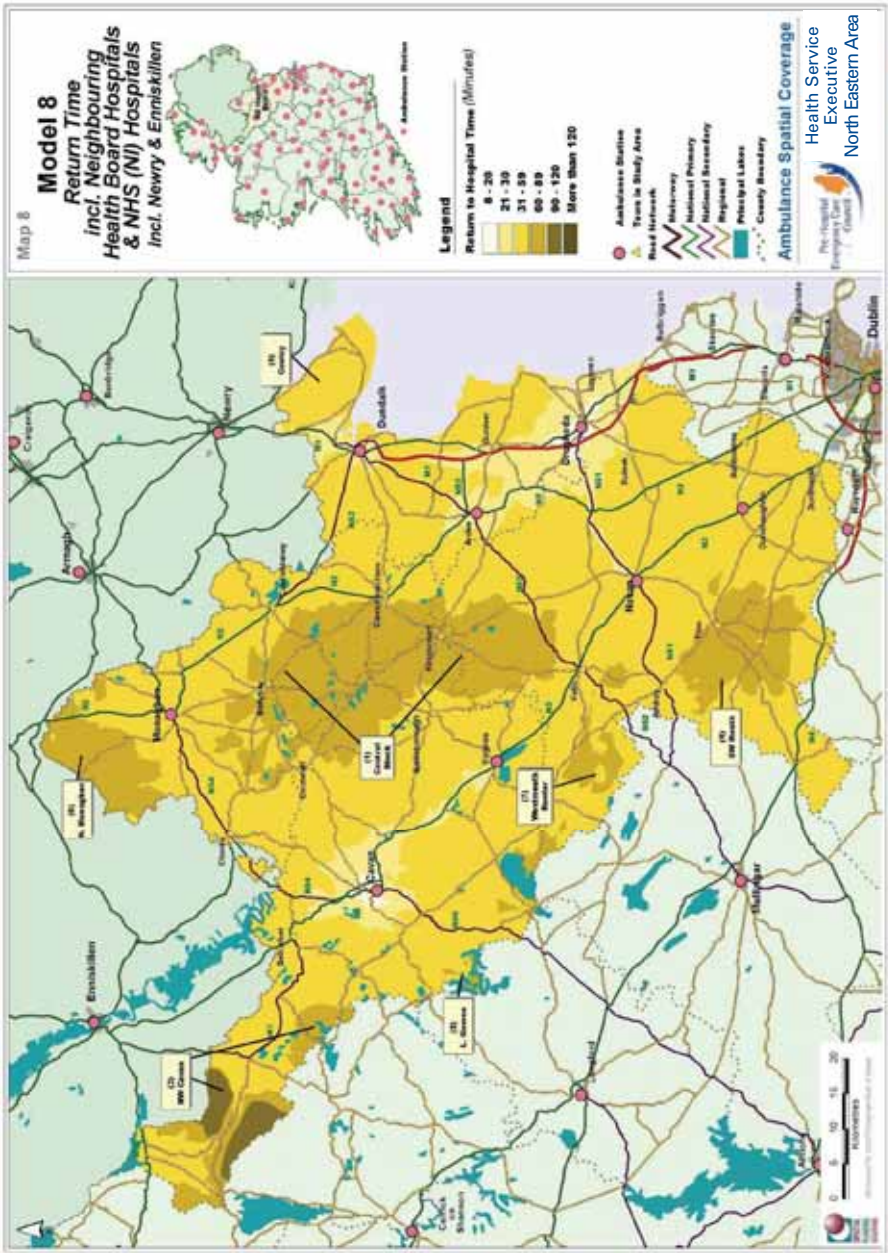
Return-to-Hospital RTA's 1997 - 2001 *(Model 8)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Central Block (1)	173	*4.4%*	*15*	*5.0%*	65	*6.0%*	216	*3.9%*
Lake Gowna (2)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
NW Cavan (3)	9	*0.2%*	*0*	*0.0%*	4	*0.4%*	18	*0.3%*
SW Meath (4)	58	*1.5%*	*0*	*0.0%*	16	*1.5%*	88	*1.6%*
N. Monaghan (6)	20	*0.5%*	*3*	*1.0%*	8	*0.7%*	28	*0.5%*
Westmeath Border (7)	6	*0.2%*	*1*	*0.3%*	0	*0.0%*	7	*0.1%*
Outside 60 Minutes	**266**	*6.7%*	**19**	*6.4%*	**93**	*8.5%*	**357**	*6.4%*
Within 60 Minutes	**3,703**	*93.3%*	***279***	*93.6%*	**995**	*91.5%*	**5,250**	*93.6%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model

The principal reduction of out-of-target area occurs in this model within the 'Central Block' where a large strip along the Northern Ireland border and serviced by the Dublin/Monaghan road (N2) is indicated as being within target. In terms of population the out-of-target population in the 'Central Block' is estimated to be 19,264 people, a reduction of 12,295 from the previous Return-to-hospital models (39.2% reduction). Secondary emergency care services

provided from Newry eliminate all out-of-target areas from the 'Cooley' area, while services from Enniskillen reduce out-of-target populations in 'NW Cavan' and 'N Monaghan' by 1,947 and 2,771 people respectively (see Table 20).



The percentage reduction of the numbers of RTA's that were recorded as occurring within the 'Central Block' is 49.3%, with 341 RTA's identified in Models 6 & 7 and 173 identified in model 8 (see Tables 19 & 21). This relatively higher level of reduction of RTA's compared to population reflects the elimination of the N2 roadway from the out-of-target area where higher numbers of vehicles travelling increase the numbers of RTA's than on other roads in the area (see Table 21).

3.4 Model 9 Use of AP Services (Intervention time)

This model examines the potential impact on the use of Advanced Paramedic (AP) services provided from locations in Monaghan and Navan. These locations were chosen on the basis of their centrality to areas of weak spatial cover in relation to Return-to-hospital times presented in the models above.

In this model, model 9, the Ambulance and hospital services put forward in model 8 are utilised and the AP services are overlaid on to these. The pattern that emerges is that almost the entire region can be serviced within the target intervention time of 60-minutes; Map 9 indicates that only the upland areas in NW Cavan and the isolated land block around Lough Gowna remain beyond this target. In total this leaves 1,431 people resident in out-of-target areas or 0.4% of the region's population. RTA rates are low in these areas and just 9 RTA's occurred in out-of-target areas between 1997 ands 2001 (see Tables 22 & 23).

Table 22

Return-time Populations *(Model 9)*

Location	Total Population			
	2002	***%***	***1996***	***%***
Lough Gowna (2)	513	*0.1%*	477	*0.2%*
NW Cavan (3)	918	*0.3%*	881	*0.3%*
Outside 60 Minutes	**1,431**	*0.4%*	**1,358**	*0.4%*
Within 60 Minutes	**343,534**	*99.6%*	**304,797**	*99.6%*
Total	*344,965*	*100%*	*306,155*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 23

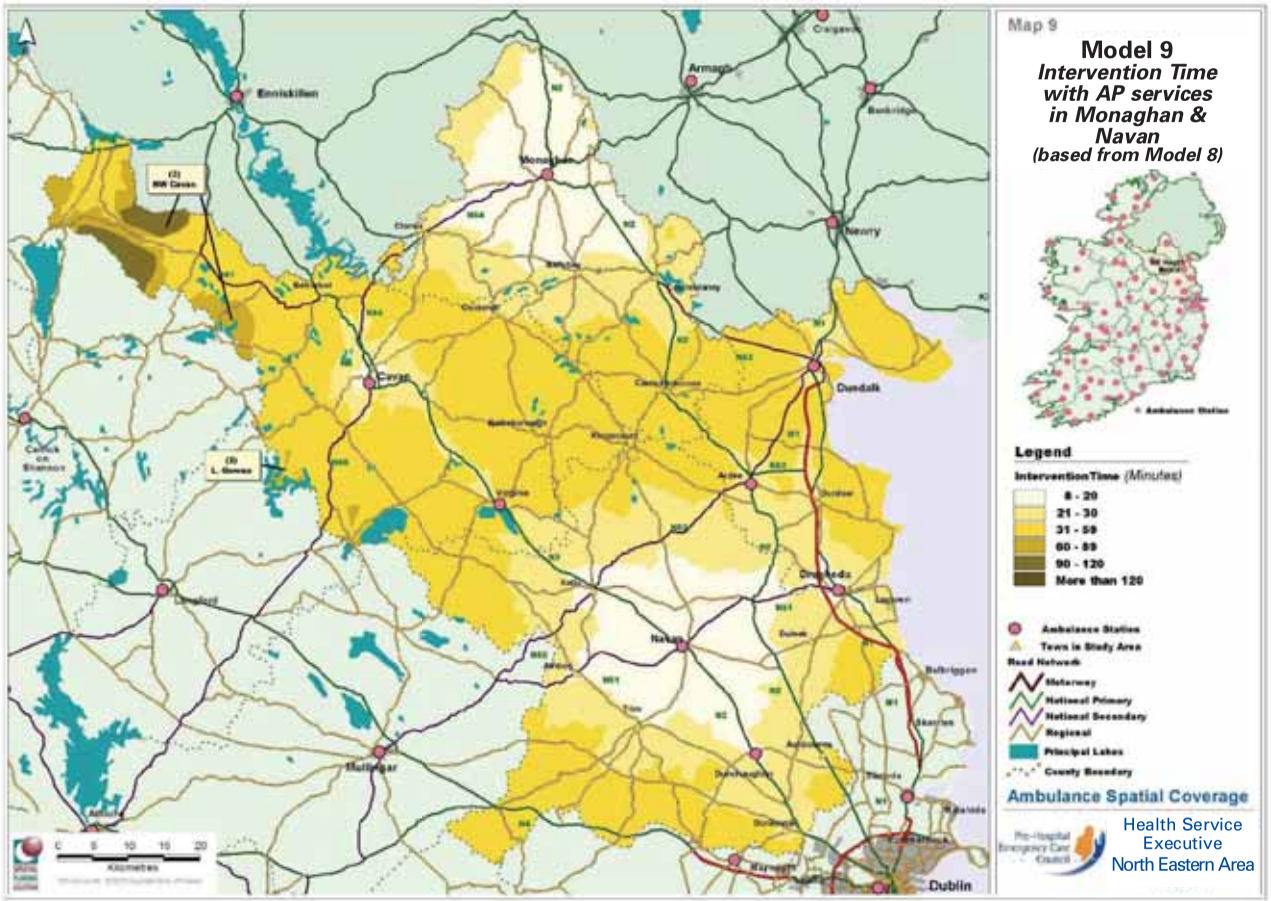
Return-to-Hospital RTA's 1997 - 2001 *(Model 9)*

Location	RTA's		Fatal Injuries		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Lake Gowna (2)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
NW Cavan (3)	9	*0.2%*	*0*	*0.0%*	4	*0.4%*	18	*0.3%*
Outside 60 Minutes	**9**	*0.2%*	**0**	*0.0%*	**4**	*0.4%*	**18**	*0.3%*
Within 60 Minutes	**3,960**	*99.8%*	***298***	*100%*	**1,084**	*99.6%*	**5,589**	*99.7%*
Total	*3,969*	*100%*	*298*	*100%*	*1,088*	*100%*	*5,607*	*100%*

Source: NRA Road Traffic Accidents Database, SPS Drive-time Model

The relative distance between of the two possible AP deployment points in Navan and Monaghan results in little overlap between the service catchments of each location. AP services in Monaghan primarily address the out-of-target areas identified in Model 8 in 'N. Monaghan' and the northern parts of the 'Central Block'. Navan in turn address the remaining out-of-target areas in 'SW Meath', 'Westmeath Border' and southern portions of the 'Central Block'.

Without emergency services from Northern Ireland the areas identified in 'Cooley' and 'NW Cavan' in model 7 would not be within target with the deployment of AP services from Monaghan and Navan and their respective population and RTA's figures would be as per model 7.


Map 9
Model 9
Intervention Time with AP services in Monaghan & Navan
(based from Model 8)
Legend
InterventionTime (Minutes)
0 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Ambulance Station
Town in Study Area
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Eastern Area
Enniskillen
Armagh
Newry
Dundalk
Cavan
Monaghan
Navan
Dublin
Kilometers

4. Conclusions and Recommendations

4.1 Conclusions

1. The use of Ambulance service operating from Virgina Co. Cavan has a significant impact on Response times for Ambulance services in the region. Within the modelling exercise in this study there was a 54% reduction in the numbers of people living in out-of-target locations when Virgina was included in the model.

2. Comparisons made between the use of Virgina and Bailieborough as Ambulance deployment points indicate that Virginia is better placed to service the area.

3. Use of Ambulance stations from neighbouring HSE areas increases the areas found to be within the 25-minute response target. A 73% reduction of people living outside the response target from the baseline model was found to occur.

4. Use of Ambulance stations from Northern Ireland further reduced the areas that were beyond the 25-minute target. Given the relatively low numbers remaining in out-of target areas the impact is less dramatic than the reductions resulting from the use of neighbouring HSE areas, however in terms of later analysis on 'Return-to-hospital' times, services from the Northern Ireland can have a very important role (see conclusion 8 below).

5. Modelling of a new deployment point in Ballyconnell Co. Cavan indicated that effectively all the population and RTA's remaining in out-of-target areas in NW Cavan (2,536 people and 18 RTA's) could be responded to within 25 minutes after factoring in the use of Ambulance services from neighbouring areas. However when included with services from Northern Ireland the effective additional population taken within target when Ballyconnell is included is 844 people or 0.2% of the region's population. This suggests that development of a new deployment point at Ballyconnell will have a marginal impact on the service pattern within the region; particularly if the use of emergency services in Northern Ireland is available.

6. The baseline Return-to-hospital model (model 6) indicated that 72,596 people (21% of the regions population) lived in areas beyond the 60-minute target time.

7. Use of neighbouring secondary emergency care centres in Beaumont, Mullingar and Sligo in model 7 reduced the out-of-target population by 19.1% to 58,703 people (RTA figures were reduced by a comparable percentage).

8. Additional use of secondary emergency care centres in Enniskillen and Newry in Northern Ireland in model 8 had a significant positive impact on the numbers of people and RTA's based in out-of-target locations. The model indicated an estimated out-of-target population of 37,292 (10.8% of regional population). This figure represents a reduction of 51.4% from the baseline model (model 6). RTA figures were found to reduce by a higher percent due to inclusion of RTA's that occurred on the Dublin/Monaghan Road into areas within the 60-minute target.

9. Monaghan & Navan are well located to provide AP services in the region; they are centrally located to relatively highly populated out-of-target locations identified in model 8 and are distant enough from both each other and the hospitals utilised in the models to allow them serve significant independent catchments. Model 9 indicates that with the use of AP services at these locations just 0.4% of the regions population, located primarily in isolated areas of north western Cavan, were found to be in out-of-target areas.

4.2 Recommendations

1. Assessment of the Health area's Ambulance resources and secondary care centres should take account of neighbouring resources located both within the Republic of Ireland and in Northern Ireland. Analysis of actual incident records within the North Eastern area would assist such evaluations.

2. Development of a new deployment point at Ballyconnell will have a marginal impact on the service pattern within the region; the use of a Community Responder Scheme in this area is recommended.

3. AP services based in Monaghan and Navan together with full use of neighbouring emergency services are recommended to ensure that the majority of the region can have intervention times of less than 60-minutes. Monaghan and Navan are optimal locations to base AP services to attain maximum coverage of the NE area and achieve intervention times of less than 60 minutes.