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

Pre-Hospital Emergency Care Council

July 2005

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A Report for the

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and the

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TABLE OF CONTENTS

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 broad 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 sections on 'Return-to-hospital' times assume that within the region secondary emergency care is provided from hospitals in Sligo and Letterkenny General Hospitals.

In addition to standard Emergency Medical Technician (EMT) services, Advanced Paramedic (AP) services are modelled from a number of locations; these are evaluated 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			
Region	**Station**	**COUNTY**	**Cover (Jan. 2005)**
NW	Ballyshannon	Donegal	24-Hour 'On-Duty'
NW	Carndonagh	Donegal	24-Hour 'On-Duty'
NW	Donegal	Donegal	24-Hour 'On-Duty'
NW	Dungloe	Donegal	24-Hour 'On-Duty'
NW	Killybegs	Donegal	24-Hour 'On-Duty'
NW	Letterkenny	Donegal	24-Hour 'On-Duty'
NW	Lifford	Donegal	Shared service 'On-Duty' with Stranolar
NW	Stranolar	Donegal	Shared service 'On-Duty' with Lifford
NW	Carrick on Shannon	Leitrim	24-Hour 'On-Duty'
NW	Manorhamilton	Leitrim	24-Hour 'On-Duty'
NW	Sligo	Sligo	24-Hour 'On-Duty'

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.

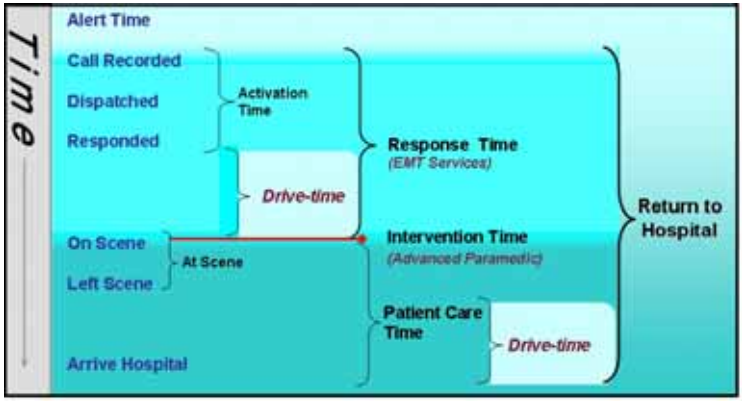
[1] The authors use the term 'Spatial Cover' to differentiate between it and the term 'Ambulance Cover' which relates to hours of availability and staffing arrangements at individual stations.

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 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 *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 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-Western 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 (Baseline).** Quantifies the 'Response' times from the use of existing Ambulance stations as listed in Table 1.

ii) **Model 2** Quantifies potential contribution from use of Ambulance stations in neighbouring HSE areas in Republic of Ireland. The Ambulance stations used in this analysis were Ballina, Boyle and Longford (HSE Western area) and Cavan (HSE North Eastern area) .

iii) **Model 3** Evaluates the impact of the utilisation of the Northern Ireland Ambulance Service with services from stations in Derry, Enniskillen, Strabane and Castlederg.

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

Again a number of scenarios are examined:

iv) **Model 4 (Baseline 'Return-to-hospital' Time).** Evaluation of 'Return-to-hospital' times using existing Ambulance resources within the region providing standard EMT services with two hospitals (Sligo and Letterkenny Regional Hospitals) providing secondary emergency care. The 'Response' times are based on model 1.

v) **Model 5** Examination of the potential impact on 'Return-to-hospital' where both EMT Ambulance services and secondary emergency services are provided from neighbouring Health Areas. The 'Response' times are based on model 2 and additional secondary emergency care centres examined are Castlebar and Cavan hospitals.

vi) **Model 6** Examination of the additional use of Ambulance and Hospital services from Northern Ireland. The model uses 'Response' times from model 3 and includes additional secondary emergency service provision from Altnagelvin and Enniskillen hospitals.

vii) **Model 7 ('Intervention' Time)** Examination of the potential impact on 'Intervention' times through the use of AP services. A number of location options for AP services were examined. The locations presented in this model are Sligo and Letterkenny. 'Response' times are based on Model 3.

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 Current Ambulance provision in HSE NW Area only

The 'Response' times portrayed in Map 1 and the respective population and Road Traffic Accident data are provided in Tables 4 & 5 below.

Table 4

Response-time Populations (Model 1)				
Location	**Total Population**			
	2002	***%***	***1996***	***%***
E Leitrim (1)	2,997	*1.4%*	3,059	*1.5%*
SW Sligo (2)	10,060	*4.5%*	9,974	*4.7%*
Mid Donegal (3)	196	*0.1%*	229	*0.1%*
N Donegal (4)	8,605	*3.9%*	8,748	*4.1%*
Islands (5)	543	*0.2%*	602	*0.3%*
Outside 25 Minutes	**22,401**	*10.1%*	**22,612**	*10.7%*
Within 25 Minutes	**199,173**	*89.9%*	**188,260**	*89.3%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

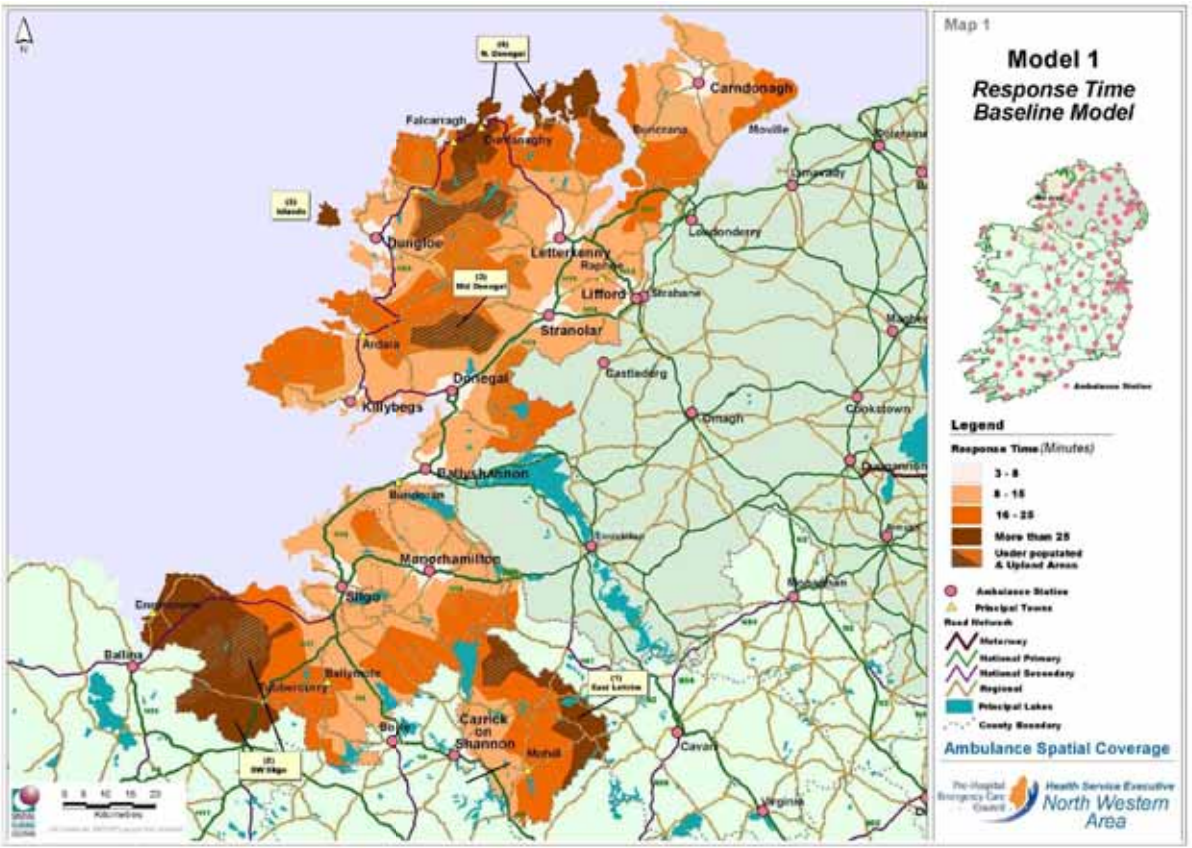
Table 5

Response-time RTA's 1997 - 2001 *(Model 1)*								
Location	**RTA's**		**Fatal Inj.**		**Serious Inj.**		**Minor Inj.**	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	24	*1.1%*	*1*	*0.6%*	9	*1.2%*	29	*1.0%*
SW Sligo (2)	73	*3.4%*	*7*	*4.1%*	24	*3.3%*	88	*2.9%*
Mid Donegal (3)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
N Donegal (4)	28	*1.3%*	*1*	*0.6%*	18	*2.5%*	40	*1.3%*
Islands (5)	1	*0.6%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 25 Min.	**126**	*5.8%*	**10**	*5.8%*	**51**	*7.0%*	**157**	*5.2%*
Within 25 Min.	**2,039**	*94.2%*	***162***	*94.2%*	**678**	*93.0%*	**2,853**	*94.8%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

In total 22,400 people (10.1% of the region's population) were resident in areas outside the 25-minute target 'Response' times. The most significant area is located in South West Sligo along the Mayo border and extending into the Ox Mountains with over 10,000 people resident. The north Donegal coastline around Falcarragh has a relatively high population density for such an isolated rural area and the 8,600 people found resident in the out-of-target area in North Donegal reflects this.

A significant out-of target population is also found in the eastern part of County Leitrim along the Cavan border where 2,997 people are located and 24 RTA's occurred.

In addition to the three principal areas of poor spatial cover listed above other areas found outside the response target were a large but relatively unpopulated area in mid Donegal around the Blue Stack Mountains and the areas within Aran and Tory Islands.


Map 1
Model 1
Response Time
Baseline Model
Legend
Response Time (Minutes)
3 - 8
8 - 15
15 - 25
More than 25
Under populated & Upland Areas
Ambulance Station
Principal Towns
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area
Carndonagh
Falcarragh
Buncrana
Moville
Dunfanaghy
Dunglow
Letterkenny
Raphoe
Lifford
Strabane
Stranolar
Ardara
Donegal
Killybegs
Castlederg
Omagh
Cookstown
Ballyshannon
Bundoran
Manorhamilton
Sligo
Ballina
Ballaghaderreen
Carrick on Shannon
Boyle
Mohill
Cavan
Virginia
Loughrea

2.2 Model 2 Use of Neighbouring Stations

Ambulance stations from neighbouring HSE areas are included in this model and how they can potentially be of assistance to emergency services in the North Western Area is demonstrated. In an earlier study that examined the distribution of Ambulance service in the region the methodology excluded the use of Ambulance resources from neighbouring HSE areas[5]. This aspect of the methodology facilitated clarity of the response capability of Ambulance services within each separate Health region. 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 additional stations included in the analysis are Ballina, Boyle and Longford (HSE Western Area), and Cavan (HSE NE area). As with all models, cover is assumed to be 24/7 'on-duty' from all these stations.

Table 6

Response-time Populations (Model 2)

Location	Total Population			
	2002	*%*	*1996*	*%*
E Leitrim (1)	2,591	*1.2%*	2,662	*1.3%*
SW Sligo (2)	2,018	*0.9%*	2,052	*1.0%*
Mid Donegal (3)	196	*0.1%*	229	*0.1%*
N Donegal (4)	8,605	*3.9%*	8,748	*4.1%*
Islands (5)	543	*0.2%*	602	*0.3%*
Outside 25 Minutes	**13,953**	*6.3%*	**14,293**	*6.8%*
Within 25 Minutes	**207,621**	*93.7%*	**196,579**	*93.2%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 7

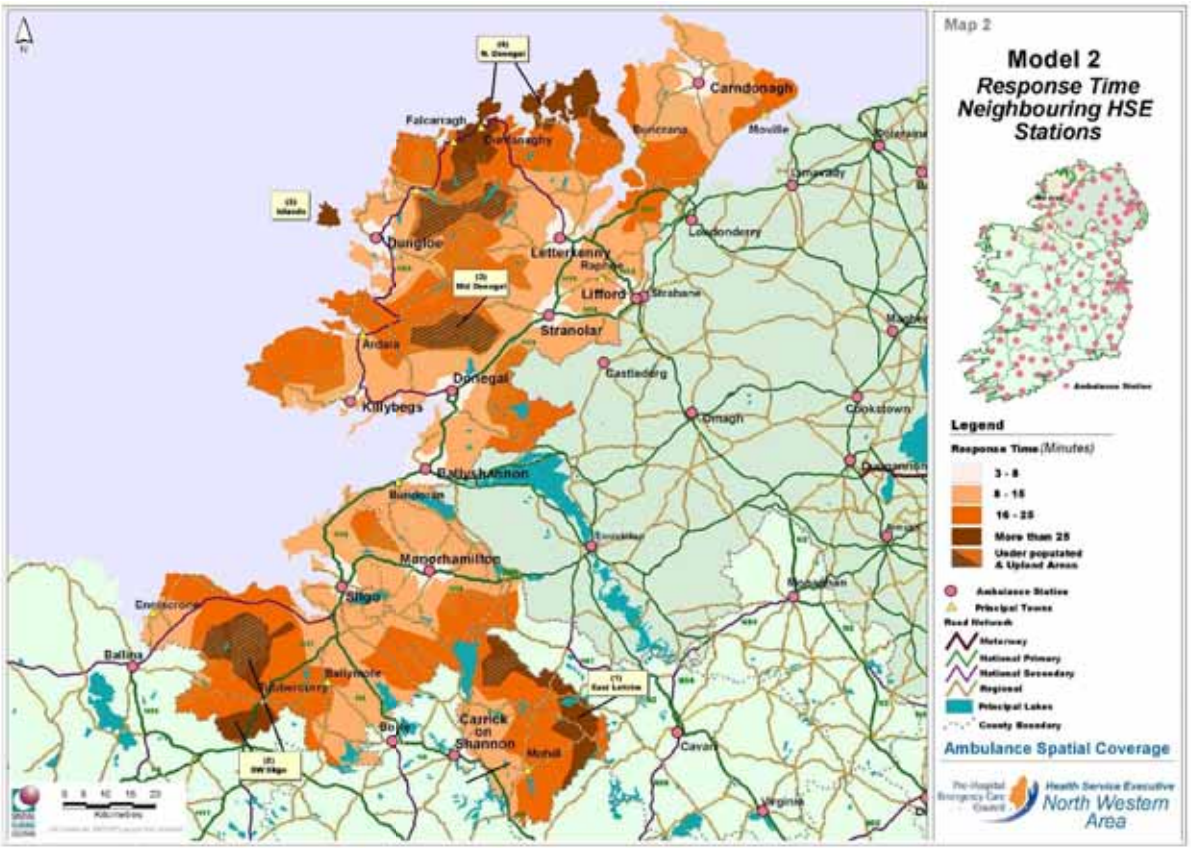
Response-time RTA's 1997 - 2001 (Model 2)

Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	24	*1.1%*	*1*	*0.6%*	9	*1.2%*	29	*1.0%*
SW Sligo (2)	17	*0.8%*	*3*	*1.7%*	0	*0.0%*	20	*0.7%*
Mid Donegal (3)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
N Donegal (4)	28	*1.3%*	*1*	*0.6%*	18	*2.5%*	40	*1.3%*
Islands (5)	1	*0.6%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 25 Min.	**70**	*3.2%*	**6**	*3.5%*	**27**	*3.7%*	**89**	*3.0%*
Within 25 Min.	**2,095**	*96.8%*	***166***	*96.5%*	**702**	*96.3%*	**2,921**	*97.0%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

[5] Moore, D. & Murphy .A.M. (2002) "Spatial Analysis – Ambulance Service, Western and North Western Health Boards", unpublished report to the Western and North Western Health Boards, 2002.

The overall impact of the use of neighbouring station is to reduce the out-of-target population from 10.1% to 6.3%, corresponding to a reduction in out-of-target population of 38%. Use of Ambulance services from Ballina had by far the most significant impact with a reduction in the out-of-target population of 8,042 people. There were only minor improvements in 'Response' times with the inclusion of the other stations in the model. In population terms an additional 406 people were located in areas within the response target from the use of the other stations excluding Ballina. The poor road infrastructure in this area considerably reduces the ability of Ambulances from either Longford or Cavan to make a substantial impact on the target 'Response' times.


Map 2
Model 2
Response Time
Neighbouring HSE
Stations
Legend
Response Time (Minutes)
3 - 8
8 - 15
16 - 25
More than 25
Under populated & Upland Areas
Ambulance Station
Principal Town
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area
Carndonagh
Falcarragh
Buncrana
Moville
Dunglow
Letterkenny
Lifford
Strabane
Stranolar
Ardara
Donegal
Killybegs
Castlederg
Omagh
Cookstown
Ballyshannon
Manorhamilton
Sligo
Enniscrone
Ballina
Ballymote
Tubbercurry
Boyle
Carrick on Shannon
Mohill
Cavan
Virginia

2.3 Model 3 Additional Ambulance Services from NIAS

Despite a series of NIAS Ambulance stations being located adjacent to the border none are positioned close to the principal areas found out-of-target in models 1 and 2. Ambulance stations located in Derry, Strabane and Castlederg had no impact on the target 'Response' times. Services from Enniskillen were capable of reaching parts of the East Leitrim area according to the model. This reduced the out-of-target population by 311 people and out-of-target RTA's by 2.

Table 8

Response-time Populations (Model 3)

Location	Total Population			
	2002	*%*	*1996*	*%*
E Leitrim (1)	2,280	*1.0%*	2,336	*1.1%*
SW Sligo (2)	2,018	*0.9%*	2,052	*1.0%*
Mid Donegal (3)	196	*0.1%*	229	*0.1%*
N Donegal (4)	8,605	*3.9%*	8,748	*4.1%*
Islands (5)	543	*0.2%*	602	*0.3%*
Outside 25 Minutes	**13,642**	*6.2%*	**13,967**	*6.6%*
Within 25 Minutes	**207,932**	*93.8%*	**196,905**	*93.4%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

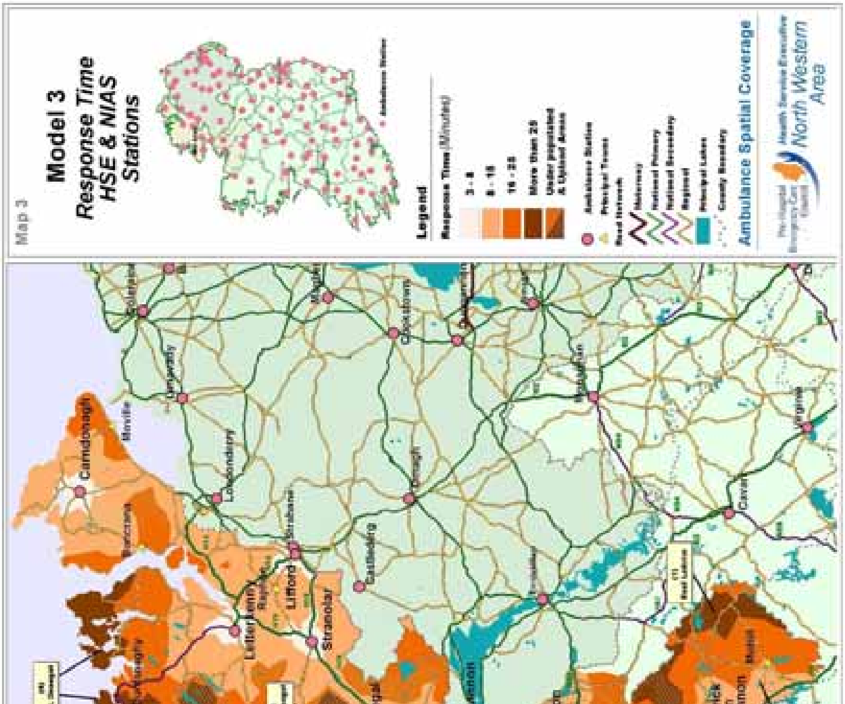
Table 9

Response-time RTA's 1997 - 2001 ***(Model 3)***

Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	22	*1.0%*	*1*	*0.6%*	8	*1.1%*	27	*0.9%*
SW Sligo (2)	17	*0.8%*	*3*	*1.7%*	0	*0.0%*	20	*0.7%*
Mid Donegal (3)	0	*0.0%*	*0*	*0.0%*	0	*0.0%*	0	*0.0%*
N Donegal (4)	28	*1.3%*	*1*	*0.6%*	18	*2.5%*	40	*1.3%*
Islands (5)	1	*0.6%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 25 Min.	**68**	*3.1%*	**6**	*3.5%*	**26**	*3.6%*	**87**	*2.9%*
Within 25 Min.	**2,097**	*96.9%*	***166***	*96.5%*	**703**	*96.4%*	**2,923**	*97.1%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

Although use of additional services from Northern Ireland does not have a significant impact on the response target the reduction in 'Response' times for areas around Derry and the Fermanagh/Tyrone border do impact on the later analysis when 'Return-to-hospital' targets are assessed (see model 8).


Map 3
Model 3
Response Time
HSE & NIAS
Stations
Legend
Ambulance Spatial Coverage
Health Service Executive
North Western
Area
Carndonagh
Buncrana
Moville
Londonderry
Letterkenny
Lifford
Strabane
Stranorlar
Donegal
Dungloe
Falcarragh
Ardara
Killybegs
Ballyshannon
Bundoran
Manorhamilton
Sligo
Carrick on Shannon
Ballina
Cavan
Omagh

2.4 Response Time Findings

The 'Response' times for current Ambulance stations providing emergency response services in the North Western area only were assessed in Model 1. The total number of people and RTA's found in out-of-target locations were 22,401 and 126 respectively. Three principal areas within the region were found to lie beyond the 25-minute target, the combined population of these out-of-target areas was found to be 21, 662 people and 125 RTA's. The areas consisted of the Eastern border of county Leitrim (2,997 people), South West Sligo (10,060 people) and North Donegal (8,605 people). In addition two further areas were found to be out-of-target in mid Donegal around the Blue stack mountains (196 people) and the Islands of Aran and Tory (543 People). In comparison with other HSE regions the North Western Area had the third highest population located in areas beyond the 25-minute target when only Ambulance services within the region are utilised.

Table 10 **National Results of Base-line 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

Model 2 introduced Ambulance services from neighbouring HSE areas. Services from Ballina in particular had a significant impact on the target 'Response' times with a reduction of 8,042 people living in out of target areas in South West Sligo. The impact of other neighbouring HSE Ambulance stations was not as substantial with a reduction of just 406 people from the East Leitrim out-of-target area being serviced from stations in Longford and Cavan.

The use of Ambulance services from Northern Ireland was included in model 3. In this instance although the four stations assessed were located close to the border they were not adjacent to the principal out-of-target areas and their impact on the response target for the North West was small with a reduction of out-of-target population of just 311 people. The NIAS Ambulance station at Strabane can significantly assist services to East Donegal if Ambulance services are unavailable in Lifford.

The three response models assessed the 'Response' times for all currently operating Ambulance stations in the region and found that with the inclusion of Ambulance services from neighbouring HSE areas and Northern Ireland that 6.2% of the population (13,642 people) and 3.1% of the RTA's (68 RTA's during the study period) were located in areas beyond the 25-minute response target. These areas are primarily located in three areas, North Donegal, SW Sligo and East Leitrim. The HSE NW area has already put in place under a pilot scheme a rapid

response vehicle that addresses the out-of-target areas in North Donegal. The East Leitrim area may also benefit from a First Responder initiative, particularly given that there are out-of-target areas across the border in Co. Cavan (see HSE North East Report in this series) and population levels do not justify development of a new Ambulance station in the Leitrim area. For the out-of-target area in South West Sligo see also the report on the HSE Western Area in respect to possible additional deployment points in north Mayo.

3 Return-to-hospital & Intervention Time

The initial model in this section examines the patterns of emergency care provision firstly from the perspective of the use of the two principal hospitals in the North Western Area, Sligo and Letterkenny. Additional models examine the impact from the use of neighbouring HSE hospitals (Castlebar & Cavan) and then secondary emergency care centres in Northern Ireland (Altnagelvin and Enniskillen). These models are concerned with the total time elapsed from receipt of emergency call to arrival at a secondary emergency care centres, as such this time is described as 'Return-to-hospital' time and a target of 60-minutes is set. The final model examines the impact on emergency care provision with the use of AP Ambulance services. As such the time to arrival at scene is taken and described as 'Intervention' time. The 'Intervention' time utilises the hospitals as in the 'Return-to-hospital' models and indicates the types of geographic service patterns that emerge through the use of both AP and conventional EMT Ambulance services.

3.1 Model 4 Return-to-hospital – Baseline Model

With two secondary emergency care centres assumed and the use of model 1 'Response' times (i.e. only Ambulance services based in the North West) the baseline population found to reside in areas beyond the 60-minute target is 75,660 people (34.1% of region's population) and 593 RTA's occurred during the study period (27.4%).

Four extensive areas were found to be out-of-target (see Map 4), the largest of which was in North Donegal with 36,316 people, followed by East Leitrim (14,666 people) and West and Mid Donegal (see Tables 11 & 12).

Table 11

'Return-to-hospital' Populations (Model 4)

Location	Total Population			
	2002	***%***	***1996***	***%***
E Leitrim (1)	14,666	*6.6%*	14,779	*7.0%*
SW Sligo (2)	10,819	*4.9%*	10,695	*5.1%*
W & Mid Donegal (3)	12,682	*5.7%*	12,995	*6.2%*
N Donegal (4)	36,316	*16.4%*	35,067	*16.6%*
Fermanagh Border (5)	634	*0.3%*	706	*0.3%*
Islands (6)	543	*0.2%*	602	*0.3%*
Outside 60 Minutes	**75,660**	*34.1%*	**74,844**	*35.5%*
Within 60 Minutes	**145,914**	*65.9%*	**136,028**	*64.5%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

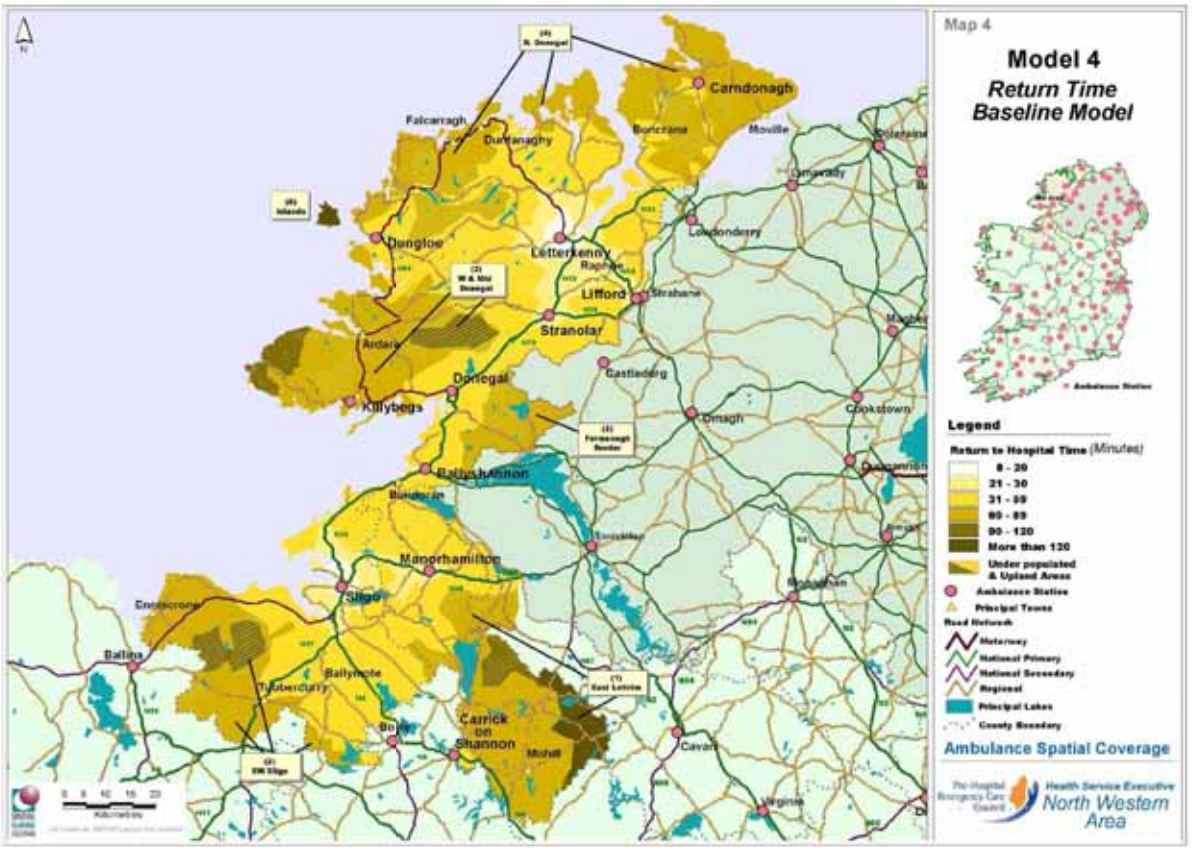
Table 12

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

Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	142	*6.6%*	*10*	*5.8%*	47	*6.4%*	173	*5.7%*
SW Sligo (2)	77	*3.6%*	*8*	*4.7%*	26	*3.6%*	98	*3.3%*
W & Mid Donegal (3)	110	*5.1%*	*6*	*3.5%*	60	*8.2%*	153	*5.1%*
N Donegal (4)	252	*11.6%*	*17*	*9.9%*	91	*12.5%*	363	*12.1%*
Fermanagh Border (5)	11	*0.5%*	*0*	*0.0%*	4	*0.5%*	20	*0.7%*
Islands (6)	1	*0.0%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 60 Min.	**593**	*27.4%*	**42**	*24.4%*	**228**	*31.3%*	**807**	*26.8%*
Within 60 Min.	**1,572**	*72.6%*	***130***	*75.6%*	**501**	*68.7%*	**2,203**	*73.2%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

The geographic pattern that emerges is that significant parts of the region lie at some distance from the secondary emergency care centres. In contrast to the response targets where around 10% of the population were out-of-target a considerably higher figure of 34.1% of the population are located in areas that represent a challenge to emergency services to provide emergency treatment within 60-minutes.


Map 4
Model 4
Return Time
Baseline Model
Carndonagh
Falcarragh
Dunfanaghy
Buncrana
Moville
Dungloe
Letterkenny
Raphoe
Lifford
Strabane
Stranolar
Ardara
Donegal
Killybegs
Castlederg
Omagh
Cookstown
Ballyshannon
Manorhamilton
Sligo
Enniscrone
Ballina
Ballymote
Tubbercurry
Boyle
Carrick on Shannon
Mohill
Cavan
Virginia
Legend
Return to Hospital Time (Minutes)
0 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Under populated & Upland Areas
Ambulance Station
Principal Towns
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area

3.2 Model 5 Return Time – Use of Neighbouring HSE Services

This model examines the impact of the use of both Ambulance services and hospital services in neighbouring HSE areas. The hospitals that are considered are Castlebar and Cavan.

Table 13

Return-to-hospital Populations (Model 5)

Location	Total Population			
	2002	*%*	*1996*	*%*
E Leitrim (1)	14,260	*6.4%*	14,382	*6.8%*
SW Sligo (2)	9,043	*4.1%*	8,846	*4.2%*
W & Mid Donegal (3)	12,682	*5.7%*	12,995	*6.2%*
N Donegal (4)	36,316	*16.4%*	35,067	*16.6%*
Fermanagh Border (5)	634	*0.3%*	706	*0.3%*
Islands (6)	543	*0.2%*	602	*0.3%*
Outside 60 Minutes	**73,478**	*33.2%*	**72,598**	*34.4%*
Within 60 Minutes	**148,096**	*66.8%*	**138,274**	*65.6%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 14

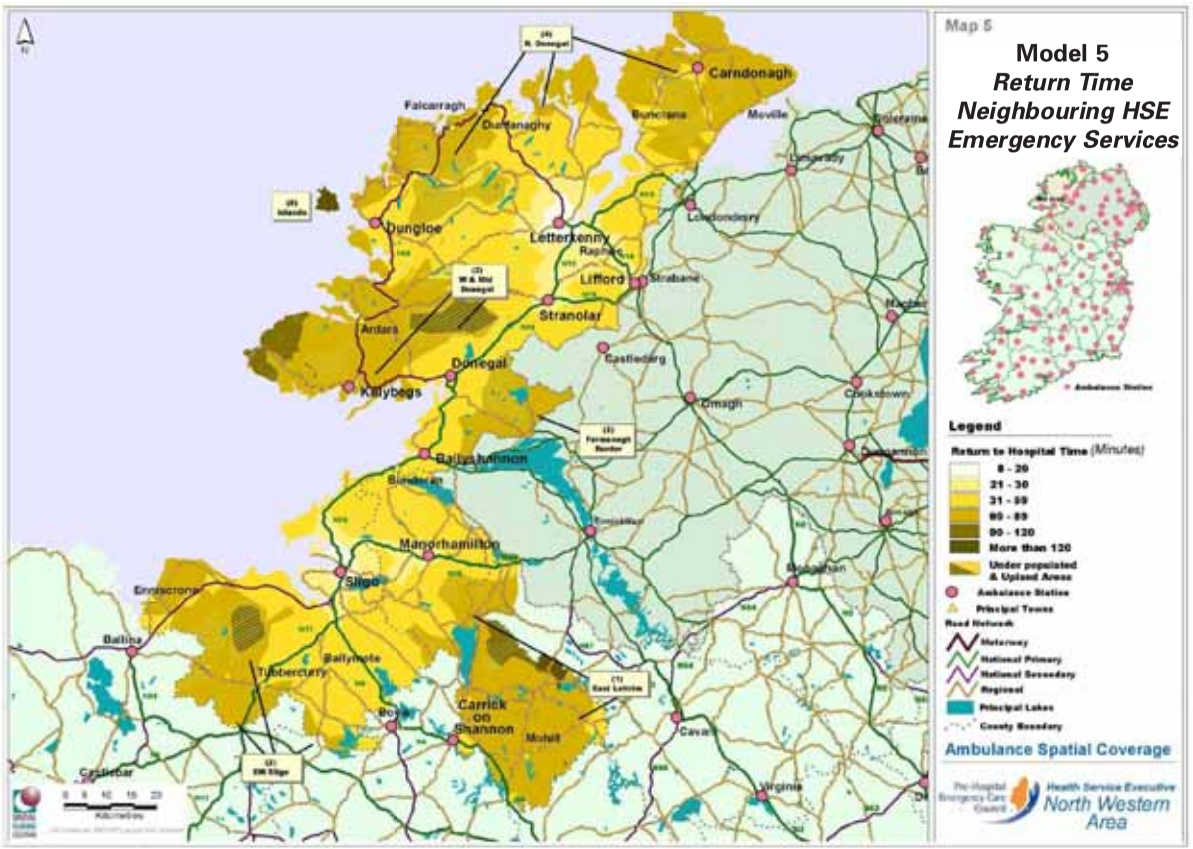
Return-time RTA's 1997 - 2001 ***(Model 5)***

Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	138	*6.4%*	*10*	*5.8%*	46	*6.3%*	168	*5.6%*
SW Sligo (2)	49	*2.3%*	*6*	*3.5%*	15	*2.1%*	65	*2.2%*
W & Mid Donegal (3)	110	*5.1%*	*6*	*3.5%*	60	*8.2%*	153	*5.1%*
N Donegal (4)	252	*11.6%*	*17*	*9.9%*	91	*12.5%*	363	*12.1%*
Fermanagh Border (5)	11	*0.5%*	*0*	*0.0%*	4	*0.5%*	20	*0.7%*
Islands (6)	1	*0.0%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 60 Min.	**561**	*25.9%*	**40**	*23.3%*	**216**	*29.6%*	**769**	*25.5%*
Within 60 Min.	**1,604**	*74.1%*	***132***	*76.7%*	**513**	*70.4%*	**2,241**	*74.5%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

Both Castlebar and Cavan are at some distance from the North Western area and this together with poor road infrastructure linking them to parts of the North West results in relatively minor reduction in the out-of-target areas. Only close to the Mayo border in South West Sligo was there a significant reduction in the out-of-target area. For this part of Sligo there was a reduction of 1,776 people and 28 RTA's based in out-of-target areas. The only other area to register a reduction was in East Leitrim where use of services from Cavan reduced the out-of-target population by 406 people.

In total between model 4 and 5 there was a reduction of 2,182 people and 32 RTA's based in out-of-target areas representing a reduction of 2.9% of population and 5.4% of RTA's.


Map 5
Model 5
Return Time
Neighbouring HSE
Emergency Services
Carndonagh
Falcarragh
Dunfanaghy
Buncrana
Moville
Dungloe
Letterkenny
Raphoe
Lifford
Strabane
Stranolar
Ardara
Donegal
Castlederg
Killybegs
Omagh
Ballyshannon
Bundoran
Manorhamilton
Sligo
Enniscrone
Ballina
Ballymote
Tubbercurry
Boyle
Carrick on Shannon
Mohill
Cavan
Castlebar
Virginia
Legend
Return to Hospital Time (Minutes)
8 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Under populated & Upland Areas
Ambulance Station
Principal Towns
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area

3.3 Model 6 *Return Times – Use of Emergency Services from Northern Ireland*

In this model Northern Irish ambulance services and secondary emergency care services are introduced and their impact on the out-of-target areas assessed. The model utilises the 'Response' times as identified in model 3. Two secondary emergency care centres were found to impact on the 60-minute target; Altnagelvin in Co. Derry and Enniskillen in Co. Fermanagh.

Table 15

'Return-to-hospital' Populations (Model 6)

Location	Total Population			
	2002	***%***	***1996***	***%***
E Leitrim (1)	13,949	*6.3%*	14,056	*6.7%*
SW Sligo (2)	9,043	*4.1%*	8,846	*4.2%*
W & Mid Donegal (3)	12,682	*5.7%*	12,995	*6.2%*
N Donegal (4)	21,403	*9.7%*	21,564	*10.2%*
Fermanagh Border (5)	135	*0.1%*	140	*0.1%*
Islands (6)	543	*0.2%*	602	*0.3%*
Outside 60 Minutes	**57,755**	*26.1%*	**58,203**	*27.6%*
Within 60 Minutes	**163,819**	*73.9%*	**152,669**	*72.4%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

Table 16

Return-time RTA's 1997 - 2001 ***(Model 6)***

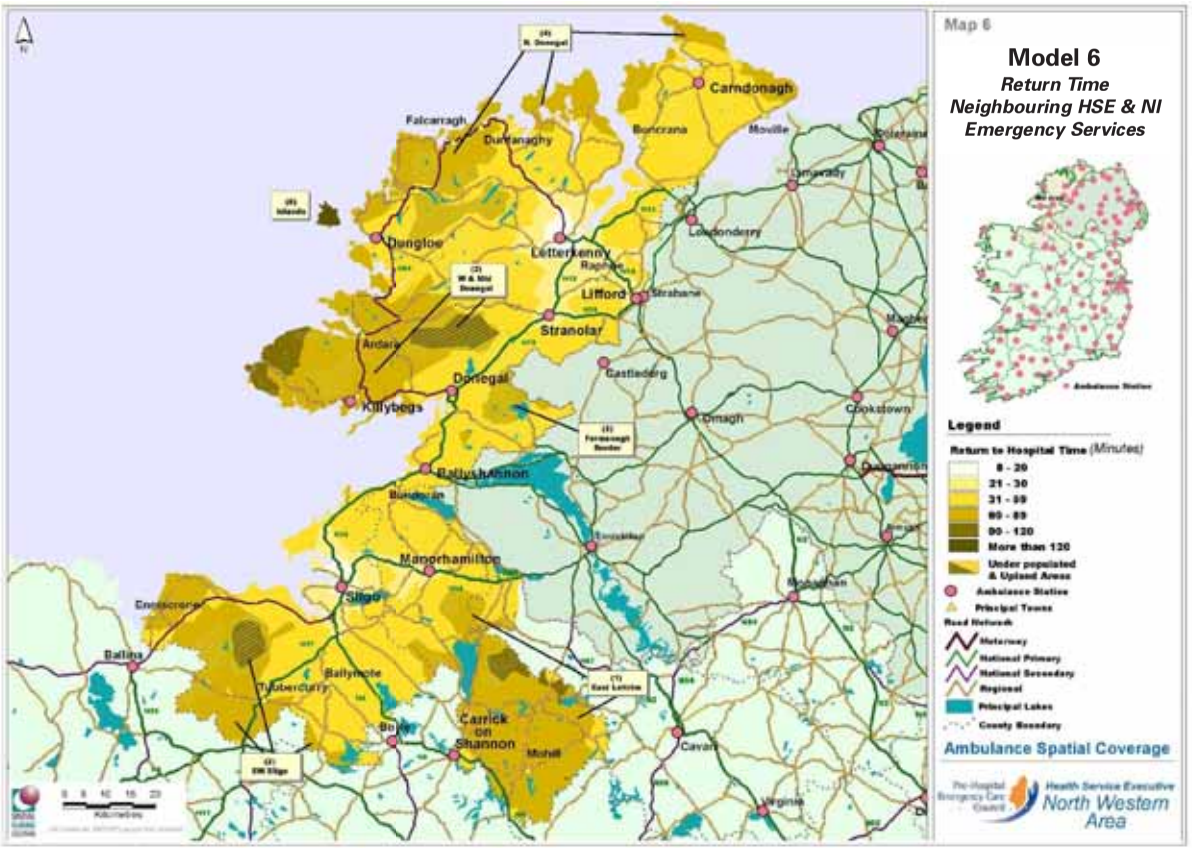
Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	132	*6.1%*	*8*	*4.7%*	43	*5.9%*	165	*5.5%*
SW Sligo (2)	54	*2.5%*	*7*	*4.1%*	17	*2.3%*	71	*2.4%*
W & Mid Donegal (3)	112	*5.2%*	*6*	*3.5%*	62	*8.5%*	160	*5.3%*
N Donegal (4)	102	*4.7%*	*6*	*3.5%*	41	*5.6%*	147	*4.9%*
Islands (6)	1	*0.0%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 60 Min.	**401**	*18.5%*	**28**	*16.3%*	**163**	*22.4%*	**543**	*18.0%*
Within 60 Min.	**1,764**	*81.5%*	***144***	*83.7%*	**566**	*77.6%*	**2,467**	*82.0%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

With both Ambulance and secondary emergency services located close to the north Donegal border in Derry it is apparent that significant reductions in out-of-target areas will occur to areas in north Donegal that were found to lie beyond the 60-minute target. From Derry large parts of the Inishowen peninsula can be addressed within the target and there is a reduction in out-of-target population in this area of 14,913 people (see Map 6 and Tables 15 & 16).

Services from Enniskillen contribute to a reduction of out-of-target areas along the Fermanagh border and to a lesser extent in East Leitrim.

Overall the services from Northern Ireland reduced the population and RTA's based in out-of-target areas by 21.4% and 28.5% respectively from model 5.


Map 6
Model 6
Return Time
Neighbouring HSE & NI
Emergency Services
Legend
Return to Hospital Time (Minutes)
8 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Under populated & Upland Areas
Ambulance Station
Principal Towns
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area
Carndonagh
Falcarragh
Dunfanaghy
Buncrana
Moville
Dungloe
Letterkenny
Raphoe
Lifford
Strabane
Londonderry
Stranolar
Ardara
Donegal
Killybegs
Castlederg
Omagh
Cookstown
Ballyshannon
Manorhamilton
Sligo
Enniscrone
Ballina
Tubbercurry
Ballymote
Boyle
Carrick on Shannon
Mohill
Cavan
Virginia

3.4 Model 7 Use of Advanced Paramedic Services (Intervention Time)

This model examines the potential impact on the use of Advanced Paramedic (AP) services provided from Sligo and Letterkenny. Other studies have examined use of AP services from neighbouring locations but none of these were found within this study to impact on target times for the North Western region.

In this model the Ambulance and hospital services put forward in model 6 are utilised and the AP services are overlaid on to these.

Table 17

'Return-to-hospital' Populations (Model 7)

Location	Total Population			
	2002	***%***	***1996***	***%***
E Leitrim (1)	4,189	*1.9%*	4,386	*2.1%*
W & Mid Donegal (3)	3,195	*1.4%*	3,280	*1.6%*
N Donegal (4)	2,246	*1.0%*	2,380	*1.1%*
Islands (6)	543	*0.2%*	602	*0.3%*
Outside 60 Minutes	**10,173**	*4.6%*	**10,648**	*5.0%*
Within 60 Minutes	**211,401**	*95.4%*	**200,224**	*95.0%*
Total	*221,574*	*100%*	*210,872*	*100%*

Source: CSO 2002, SPS Drive-time Model

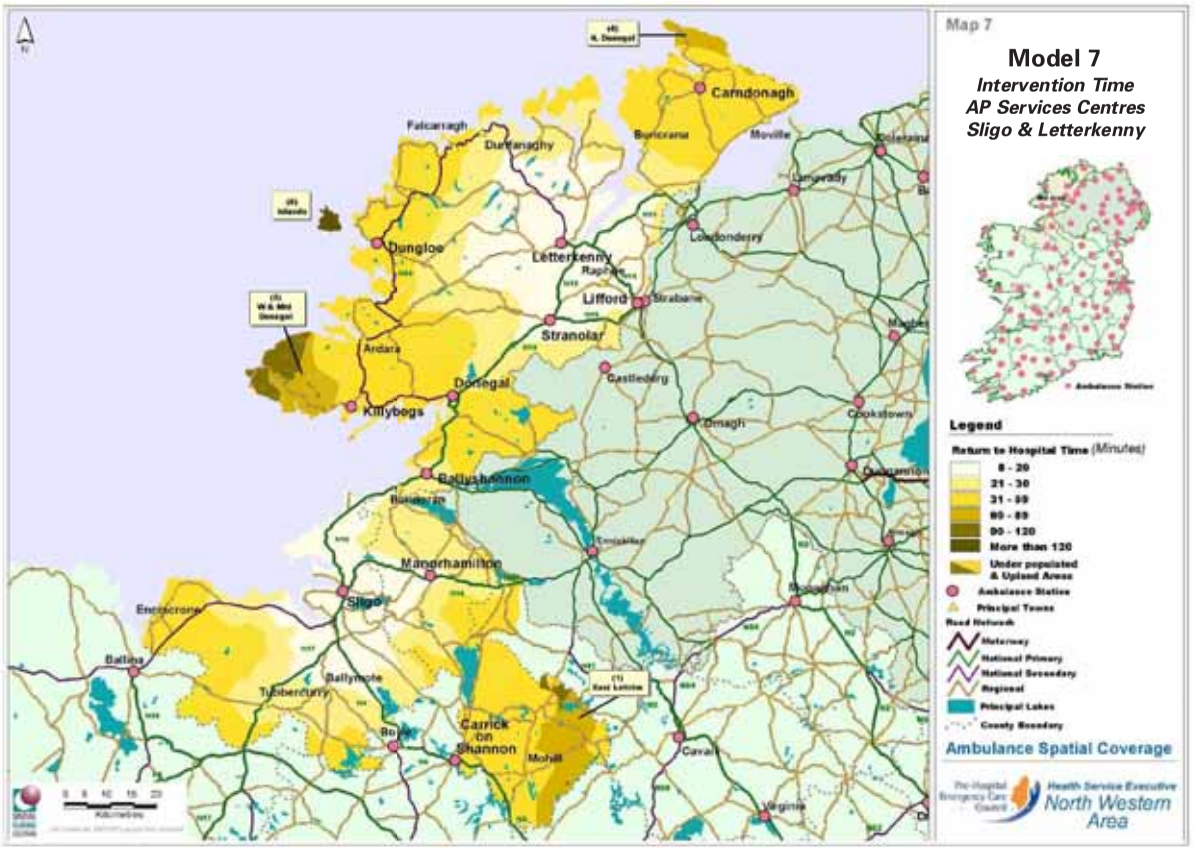
Table 18

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

Location	RTA's		Fatal Inj.		Serious Inj.		Minor Inj.	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
E Leitrim (1)	29	*1.3%*	*1*	*0.6%*	12	*1.6%*	35	*1.2%*
W & Mid Donegal (3)	14	*0.6%*	*0*	*0.0%*	9	*1.2%*	16	*0.5%*
N Donegal (4)	9	*0.4%*	*0*	*0.0%*	3	*0.4%*	13	*0.4%*
Islands (6)	1	*0.0%*	*1*	*0.6%*	0	*0.0%*	0	*0.0%*
Outside 60 Min.	**53**	*2.4%*	**2**	*1.2%*	**24**	*3.3%*	**64**	*2.1%*
Within 60 Min.	**2,112**	*97.6%*	***170***	*98.8%*	**705**	*96.7%*	**2,946**	*97.9%*
Total	*2,165*	*100%*	*172*	*100%*	*729*	*100%*	*3,010*	*100%*

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

There is a very significant impact on the numbers of people based in out-of-target areas with the introduction of AP services. There was a considerable reduction in the out-of-target areas throughout the region, in particular for North Donegal and West Donegal. In total 4.6% of the regions population (10,173 people) and 2.4% of the RTA's (53 RTA's) are located in out-of-target areas.


Map 7
Model 7
Intervention Time
AP Services Centres
Sligo & Letterkenny
Legend
Return to Hospital Time (Minutes)
0 - 20
21 - 30
31 - 59
60 - 89
90 - 120
More than 120
Under populated & Upland Areas
Ambulance Station
Principal Towns
Road Network
Motorway
National Primary
National Secondary
Regional
Principal Lakes
County Boundary
Ambulance Spatial Coverage
Health Service Executive
North Western Area
Carndonagh
Falcarragh
Dunfanaghy
Buncrana
Moville
Dungloe
Letterkenny
Raphoe
Lifford
Strabane
Londonderry
Stranolar
Ardara
Donegal
Killybegs
Castlederg
Omagh
Cookstown
Ballyshannon
Manorhamilton
Sligo
Enniscrone
Ballina
Ballymote
Tubbercurry
Carrick on Shannon
Roscommon
Mohill
Carrick on Shannon
Carrick-on-Shannon
Virginia

4. Conclusions and Recommendations

4.1 Conclusions

1) In general it was found that a relatively high level of spatial cover is apparent for 'Response' times. Spatial cover was not as strong for 'Return-to-hospital' times when Sligo and Letterkenny alone provide secondary care, however use of neighbouring hospital services from Castlebar and Northern Ireland have a significant positive impact on 'Return-to-hospital' times.

2) The baseline Response Model (model1) where the North Western Area alone provide emergency services indicated that 22,401 people and 126 RTA's (10 fatalities) were located in areas beyond the 25-minute response target.

3) The use of neighbouring Ambulance services from HSE areas only had a significant impact on the out-of-target areas located close to Ballina in the south west Sligo area. Services from Longford and Cavan had a less significant impact on out-of-target areas in east Leitrim. In total the out-of-target population when neighbouring services are used was found to be 13,953, a reduction of 37.7% from the baseline model (model 1). For RTA's the total that occurred in out-of-target location for the study period was 70 (6 fatalities).

4) Ambulance services from Northern Ireland have the potential to further reduce the out-of-target areas for Ambulance response, although not as substantially as the use of neighbouring HSE Ambulance services. In total the out-of-target population found to occur with the use of NIAS services was reduced by just 311 people and for RTA's there was a reduction of 2 (no reduction in numbers of fatalities).

5) The overall figures for out-of-target areas when the use of all neighbouring services are examined was 13,642 people (6.2% of region's population) and 68 RTA's (3.1% of RTA's that occurred in study period). The NIAS station in Strabane can potentially provide spatial cover for the Lifford/Raphoe if ambulance resources are unavailable in Lifford.

6) Initiatives to develop First Responder schemes in parts of east Leitrim that are outside the 25-minute response target would also benefit out-of-target areas in county Cavan.

7) The baseline 'Return-to-hospital' Model (model 4) where only Ambulance and emergency secondary care centres are based in the region indicated that 75,660 people (34.1% of region's population) and 593 RTA's (27.4% of RTA's occurring during study period) are located in out-of-target areas (60-minutes).

8) Use of neighbouring HSE Ambulance and hospital services reduced the out-of-target population to 73,478 people (2.9% reduction) and 561 RTA's (5.4% reduction). This reduction principally occurred from services provided from Ballina Ambulance station and Castlebar Hospital.

9) Emergency services provided from Northern Ireland had a significant impact on 'Return-to-hospital' times in the out-of-target area in North Donegal, provided from

Altnagelvin and Enniskillen. In total the areas found to be beyond the 60-minute target when emergency services in neighbouring areas in both Northern Ireland and other HSE areas are utilised had a population of 57,755 people (26.1% of region's population) and 401 RTA's occurring in the out-of-target areas (18.5% of RTA's for study period)

10) Two AP locations were assessed, Sligo and Letterkenny. AP services from these locations reduced the out-of-target areas considerably resulting in an out-of-target population of 10,173 people (4.5% of region's population) and numbers of RTA's that occurred in out-of-target areas of 53 (2.4% of RTA's for study period).

4.2 Recommendations

1) Assessment of an individual health area's Ambulance resources and secondary care centres should take account of resources located in neighbouring areas. Analysis of actual incident records will assist such evaluations.

2) Emergency care provision in East Leitrim would benefit from development of a first responder scheme that would also link into areas of poor spatial cover in county Cavan.

3) AP services from Sligo and Letterkenny have a significant impact on the 'Intervention' times for the region and are the optimum location for these services within the region.

NOTES: