National Ambulance Service of Ireland
emergency service baseline and capacity review

Undertaken by Lightfoot Solutions UK Ltd

Commissioned by the Health Service Executive

Final report 05 October 2015

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1 Executive summary

1.1 Background to the review

The purpose of this report is to present the findings and recommendations of the emergency service baseline and capacity review of the National Ambulance Service of Ireland (NAS).

The review was commissioned by the Health Service Executive (HSE) on behalf of NAS. The overall purpose of the review was to determine the underlying capacity required to deliver the standards for response performance across Ireland.

The review and this report were completed by Lightfoot Solutions UK Limited (Lightfoot). Lightfoot has extensive experience, both in the UK and internationally, of helping ambulance services and stakeholders to develop their strategic direction so that it aligns with that of the wider health economy. In this context, Lightfoot advocates a 'whole system' approach to the delivery of unscheduled care and has worked extensively with many healthcare organisations including hospitals, commissioning bodies and ambulance services.

A draft report was first prepared on the 18th February 2015 and the executive summary was published by the HSE. Following the draft report Lightfoot were commissioned to conduct more in depth modelling and set out the deployment points and resource requirements at a granular level.

In conducting this further modelling we also introduced specific modelling around a dual provision scenario in which both NAS and DFB continue to provide resources within the Dublin and Wicklow dispatch area. In this dual provision scenario it is assumed that Dublin Fire Brigade continue to provide 12, 24 hours (24/7) Double Crew Ambulances (DCAs).

This version of the capacity and baseline review, contains all of the original sections from the draft report (18th February 2015) and the following additions:

- Sections 6.3.3, 6.3.4, 6.3.5 - Activity dealt with by Dublin Fire Brigade
- Appendix G – Deployment points and resourcing analysis

It should be noted that the total additional resource requirements required to achieve best possible performance has been updated in Appendix G and now include an allowance for 6.5% activity growth.

1.2 Review approach

Our approach was set out in our proposal and agreed with NAS before the start of the review. See Appendix A for our list of jointly agreed objectives. A further set of objectives in March 2015 for the more granular modelling were also agreed.

1.2.1 Project initiation

This involved agreeing with NAS the terms of reference, deliverables and project timelines and establishing what data sources were available to support the analysis.

1.2.2 Data analysis

This involved the collection of NAS operational data taken from Computer Aided Dispatch (CAD) systems, and analysis of that data using *signalsfromnoise* (**sfn©**), Lightfoot's performance management solution that uses statistical process control techniques to interrogate data. In addition, NAS staff rotas were provided to inform the findings of the review.

1.2.3 Interviews and site visits

The Lightfoot team visited NAS and met with key managers to seek input and to test the initial analysis.

1.2.4 Playback workshops

Through a series of workshops, we developed a shared understanding of the review issues, obtained input into the review of stakeholders and built a consensus around possible solutions.

1.2.5 Preparation of the final report and recommendations

The initial Draft Client Report was submitted for comment. This was followed by a presentation of the report findings to key stakeholders. Lightfoot was then engaged to provide additional modelling of the optimal deployment points and resourcing requirements. A final updated report was then submitted for comment.

1.3 Key findings

1.3.1 Background and context

The National Ambulance Service in Ireland is a key stakeholder and service provider within the wider health system. Historically, it has not held a high profile within the HSE but current and future reforms will offer an opportunity to enhance its positioning. To be successful in this, NAS will need to continue to develop a high quality, clinically-led service that delivers excellent, timely pre-hospital care, in partnership with the key organisations and stakeholders across the health economy.

NAS is often compared to English ambulance services and, as a result, its performance targets are similar, albeit slightly higher in Ireland - 80% in 8 minutes for Echo and Delta (life-threatening and potentially life threatening) calls in Ireland and 75% in 8 minutes in England.

However, it is important to appreciate that NAS is not directly comparable to English ambulance services in a number of important respects. Even on the assumption that NAS is fully resourced and operating to international good practice standards in all of its operational processes, the theoretical best achievable performance would be 64%. O**ur analysis indicates that it could only achieve an 8 minute performance of 60.6% across Ireland**, compared to around 79% for a typical English service because of the immense difficulties with rurality in Ireland. **This means that NAS cannot possibly achieve the HIQA prescribed target of 80% in 8 minutes.**

In particular, NAS serves a much greater rural population than its English counterparts. This has major implications on the ability of NAS to perform to the same response time standards as an English

ambulance service. It is much more difficult to achieve response-time targets for calls in rural areas than urban areas because of the longer distances to drive. In Ireland, 40% of incidents are in a rural location compared to 12% in a typical English service. We have modelled the implications of this on NAS best achievable performance.

In Ireland, there are only 40% as many ambulance calls per head of population as in England. This difference cannot be fully explained, but there is some evidence that access to GPs in Ireland is easier, particularly out of hours. In addition, patients are more likely culturally to use the GP as their first point of access and to transport themselves to hospital. However, because of emerging issues with primary care, (GP man-power issues, medical graduate emigration, and reimbursement issues for GPs) it is possible that Irish ambulance calls per head may move closer to the English level. This could have implications for growth in demand over the coming years. Indeed, there is some evidence that the gap is already closing because, despite lower population growth, the NAS emergency demand growth rate is broadly comparable to the English growth rate. While recognising these risks, for the purposes of the report, we have assumed growth in emergency demand will continue at 6.5% per year.

Both the high rurality and the low level of calls per head will result in significantly higher costs per incident in Ireland than in England, although detailed analysis of this was beyond the scope of this review.

NAS has made considerable strides in a number of areas in recent years:

- Good progress has been made in rationalising control rooms and investing in new buildings and technology
- The investment in additional Intermediate Care Vehicles has produced significant benefits for patients. There remains scope to extend the use of ICVs to continue to reduce the pressure on the emergency ambulance fleet
- Given the very rural nature of the service, NAS successfully manage the number of high acuity patients waiting for extended periods for an ambulance, with only 1% waiting more than one hour. In comparison to some busy UK Ambulance Services this represents good performance.
- Strengthening clinical governance structures within the service
- Introduction of hospital bypass protocols
- Successful introduction of a dedicated Emergency Aeromedical Service

1.3.2 Performance

The review was asked to consider what response time performance could be achieved for both 8 minute and 19 minute standards for life-threatening (Echo) and potentially life-threatening (Delta) calls with the existing level of resources, and also what extra resources would be required to achieve the HIQA prescribed response time performance targets. To answer this question, we used the same model and approach that we have used in many services around the world. Our model is built to reflect the density of calls and geographical make-up of the service. It categorises the service into major urban, minor urban and rural areas to assess the resources required and the performance that can be achieved.

1.3.3 Current performance

Table 1-1 below shows current NAS performance for both 8 minute and 19 minute standards for the period March - August 2014.

Table 1-1: Echo and Delta 8-minute and 19-minute performance by population density, March – August 2014

8 minute Echo/Delta				19 minute Echo/Delta			
Major urban	**Minor urban**	**Rural**	**Total**	**Major urban**	**Minor urban**	**Rural**	**Total**
36.7%	45.6%	6.6%	26.6%	87.0%	76.7%	44.0%	67.2%

Table 1-1 illustrates the very large gap between current performance and current targets: for the 8 minute standard, current performance is 26.6% against a target of 80%; and for the 19 minute standard, current performance is 67.2% against a target of 95%. As discussed above, because of the rural nature of the area NAS serves, we do not consider these targets are achievable. The table does suggest, however, that there is scope for NAS to improve in both major and minor urban areas against good practice standards observed in other ambulance services.

1.3.4 Potential impact of improved operational processes on performance

Our analysis identified two significant opportunities for NAS to improve response times.

Firstly, there is scope, through further investment in vehicle and control room technology, and improved management focus, to reduce the time it takes from the moment the clock starts to the vehicle going mobile by about 90 seconds. This would improve NAS 8 minute performance by 6.9% and NAS 19-minute performance by 2.9%. Full achievement of the benefits of this change cannot be fully realised until new technology including mobile data and integrated satellite navigation is in place and the new centralised control room infrastructure is fully operational.

Secondly, there is scope for NAS to reduce the time it takes vehicles to drive to scene by reviewing the points from which the vehicles start (deployment points). In many cases, the ambulance stations, which are used as deployment points, are not well located for the communities they serve. As a result, average drive times in urban areas are nearly 10 minutes compared to about 4 minutes in high-performing services in other countries. We estimate that the reduced drive times would improve NAS 8 minute performance by a further 2.2% and NAS 19 minute performance by a further 0.8%. We recognise that negotiating and implementing this change will be challenging for NAS and will require significant planning time and investment in technology and facilities.

Taken together, the changes improve 8 minute performance by 9.1% and 19 minute performance by 3.7%, as shown in Table 1-2 below.

Table 1-2: Potential Echo and Delta performance with improved operational processes

8 minute Echo/Delta				19 minute Echo/Delta			
Major urban	Minor urban	Rural	Total	Major urban	Minor urban	Rural	Total
58.9%	50.1%	8.0%	35.7%	90.4%	77.6%	51.1%	70.9%

International good practice identifies Echo calls earlier in the control room process, enabling vehicles to be dispatched more quickly for patients with immediately life-threatening conditions. This is normally done by reviewing the order of the questions asked by the call taker, to identify certain key words to trigger the earlier response.

1.3.5 Impact of additional resources on performance

We also modelled the further improvement in performance that could be achieved with additional resources. These extra resources would be largely based in major and minor urban areas because the call volumes in rural areas, at less than one a day, are too low to support a dedicated ambulance vehicle. There is scope to improve response times in major urban areas by the extended use of cars (Rapid Response Vehicles – RRVs) as well as additional ambulances. In the minor urban areas, additional RRVs could be used to provide cover for when the local ambulance was not available but they would need to operate at low utilisation levels. In order to operate more efficiently it would be sensible to ensure they were integrated into the wider local health economy providing care in partnership with other health care providers.

Table 1-3 below shows the expected performance improvements that could be achieved with both the improved operational processes as described in section 1.3.4, and additional resources in the form of an extra 2365 ambulance hours, 200 ICV hours and 2,990 RRV hours per week. An additional 290 full time staff would be required to deliver these core additional hours. Table 1-4 shows these extra resources in more detail.

As can be seen, performance overall rises to 51.2% in 8 minutes and to 81.5% in 19 minutes.

Table 1-3: Potential Echo and Delta performance with improved operational processes and additional resources

8 minute Echo/Delta				19 minute Echo/Delta			
Major urban	Minor urban	Rural	Total	Major urban	Minor urban	Rural	Total
85.0%	73.2%	10.1%	51.2%	95.5%	84.1%	69.3%	81.5%

Table 1-4: Additional resource analysis – hours per week

Current Ambulance hours	Current ICV hours	Current RRV hours	Additional ambulance hours	Additional ICV hours	Additional RRV hours	Additional staff hours
18958	2440	958	2365	200	2990	8120

1.3.6 Potential impact on performance of extending the scope of CFR schemes

As can be seen from Table 1-3, the extra resources produced very little performance improvement in the rural areas. We, therefore, examined the rural area in more detail and identified 100 locations where there was up to one call per week. It would not be sensible to deploy dedicated ambulance resources in these locations and alternative solutions are required. Community first responder (CFR) schemes are programmes under which a local community acquires a defibrillator and is given training and support by the ambulance service. These schemes are widely used in many services around the world and have proved very effective in saving lives and improving patient experience, care and outcomes. They are not, however, a replacement for the ambulance service which must always back up the local volunteers.

It should be noted that Community First Responder schemes in Ireland have grown from what was originally a network of Cardiac Responder schemes and as such was designed to deal with Echo calls only and this clinical focus and method of operation has remained in place. In many other services across the world Community First Responders (CFRs) also respond to a significant sub set of Delta calls which provides improved patient experience and improved response times. In Ireland this extension to respond to additional Delta calls will require a complete re-focussing of CFR schemes coupled with major investment, a major retraining programme and associated cultural change. This will clearly take some considerable time to agree and to secure the required financial investment and potentially several years to introduce successfully.

Table 1-5 below shows the potential improvements in 8 minute performance in the rural areas that could be achieved with the introduction of 100 CFR schemes, in addition to the improved operational processes described in section 1.3.4, and additional resources outlined in section 1.3.5. It also shows the impact overall on NAS performance. Building up CFR schemes on this scale would cost a significant amount of money both in set-up and maintenance and would probably take several years to achieve. It should be noted that there is no impact on the 19 minute performance as NAS would still have to back up every CFR attendance with a transporting vehicle.

Table 1-5: Best achievable Echo and Delta performance with improved operational processes, additional resources and optimal CFR contribution

8 minute Echo/Delta				19 minute Echo/Delta			
Major urban	Minor urban	Rural	Total	Major urban	Minor urban	Rural	Total

8 minute Echo/Delta				19 minute Echo/Delta			
85.0%	73.2%	32.9%	60.6%	95.5%	84.1%	69.3%	81.5%

We estimate that the combined benefits of better operational processes, additional resources and extended use of community first responder schemes would improve 8 minute performance for Echo and Delta calls from the current level of 26.6% to 60.6% and improve 19 minute performance from the current level of 67.2% to 81.5%. These improvements would cost significant amounts of money, 290 staff alone is conservatively estimated by the NAS to cost 15m Euro in direct pay costs alone and would take up to five years to achieve fully. Improvements beyond this level are not practical or affordable, due to the rural nature of the communities that NAS serves.

1.3.7 Relief ratios

Under the 1998 National Ambulance Agreement, NAS aims to operate to a relief ratio of 30% (i.e. to cover annual leave, sick leave, training absences etc.). Our review suggests that 34% would be more appropriate based on international best practice elsewhere. This would require an additional 181 staff. However, we recognise that NAS is currently providing the vast majority of this relief through overtime so a proportion of the cost and number of staff would be offset by reduced overtime.

1.3.8 Resources required by NAS to handle the work currently performed by DFB

DFB currently provide the primary response to emergency calls in Dublin. We were asked to estimate the extra resources that NAS would require to handle DFB activity.

We estimate that an extra 2,507 ambulance hours and 588 RRV hours per week are required to enable NAS to absorb this work and achieve 8 minute performance of 85% and 19 minute performance of 95%, the modelling standard set for major urban areas. This equates to 200 full time staff.

It should be noted that our modelling work has not made any calculations regarding current DFB performance against these targets but it is our understanding from the HSE/NAS that DFB does not currently perform to the full 85% in 8 minutes and 95% in 19 minutes. As such it is important to be clear that the NAS resources described above are modelled to deliver performance levels in excess of what is currently being achieved by DFB.

1.3.9 NAS overtime levels

Front-line overtime levels in NAS are currently 20% of the pay bill. If we assume that 10 % overtime is required for shift overruns and other unavoidable causes that leaves 10 % of the pay bill that could be used to pay for extra staff. It is equivalent to around 139 staff. This could be used to offset the costs of the extra 181 staff required to provide relief cover at 34% and partially offset the further additional cost of the extra 290 staff required to deliver the best achievable performance.

1.3.10 Control room

Our initial analysis suggested that there is scope to rationalise the number of dispatching desks from nine to seven and to improve the operational processes within the control rooms. These changes will

be best realised with the introduction of the new control rooms. It should be noted that in the event of a dual provision model for the Dublin and Wicklow dispatch area (East), where all resources and incidents are deployed by NAS, an additional dispatch desk will be required.

Along with many other ambulance services around the world, NAS is facing ever-increasing demand for its services. Many of these services are developing a 'Hear and Treat' capability in their control rooms so that, where appropriate, they can offer advice to patients over the phone and avoid sending an ambulance. NAS would be able to cope better with anticipated demand increases by developing a similar approach.

Routine work has been rising ever since the introduction of Intermediate Care Vehicles (ICV) operated by NAS, due to hospitals reducing their reliance on private contracts. As Hospital Groups develop, there are opportunities for NAS to further structure their service with additional ICVs handling routine transfers. NAS should look to develop their strategy and performance in handling the routine work more efficiently to reduce the emergency ambulance load.

1.3.11 Clinical development

There are undoubted benefits associated with reduced response times for some time critical patients such as those in cardiac arrest and those with severe injuries and in severe pain. It cannot however be assumed that improved response times will yield a commensurate improvement in clinical outcomes for the majority of patients who are not time critical.

We would support a move to a wider range of targets for NAS that included more clinically based as well as response time targets. NAS have, in conjunction with PHECC, supported an academic process to identify a suite of clinical process and outcome indicators suitable for pre-hospital care in Ireland. This is now complete. With the introduction of an electronic patient care report, NAS can move to measuring and reporting against clinically based targets.This would increase the clinical focus in the service and thereby improve patient care and experience.

NAS have a general policy of conveying all patients to accident and emergency (A&E) departments. Many other services are also developing a 'see and treat' approach to providing alternative care to patients instead of simply taking them to A&E. In England, the development of alternative care pathways allows ambulance services to treat up to 50% of patients by means other than transportation to A&E. Linkages with other care providers will need to be developed in Ireland to facilitate this (e.g. out-of-hours GP co-ops, social services, community pharmacists, dental services). This approach enables services to provide more appropriate care to patients, save money for themselves and the wider health system, and develop the skills and potential of their staff.

This approach does need to be considered carefully however in the Irish context given that emergency ambulance demand is only 40% by head of population as that seen in the UK. This could potentially lead to the view which assumes the base level clinical acuity of emergency ambulance patients in Ireland is higher than that in the UK. This might suggest that the ultimate numbers transferred to ED may need to be higher than that aspired to in the UK. This hypothesis should be explored in more detail to ensure the correct conclusions are drawn.

1.3.12 Performance management

There is scope for NAS to implement a more systematic approach to day to day performance management and strategic planning. This would require considerable investment in specialised technology to support improved understanding of operational data across all levels, from management to frontline staff. In addition, we believe NAS would further benefit from adopting a structured approach to engaging staff in continuous performance improvement.

1.4 Summary of recommendations

(Listed chronologically as they appear in the report, not in priority order)

	Recommendation	Section
a	NAS should undertake further investigation into why emergency calls per head are so low in Ireland compared to England, so that future patterns of growth in Ireland can be better understood and accommodated.	2.2.1
b	NAS should work with partners in the Irish health system to establish an agreed basis for handling routine activity (inter-hospital transfers of patients) with improved utilisation of ICVs.	2.3.2
c	NAS should build on the HIQA National Standards for Safer Better Healthcare and develop a suite of appropriate clinical outcome and patient experience measures.	2.4.1
d	NAS should consult with HIQA on a review of response time targets, in the light of the conclusions of this report about their achievability.	2.4.1
e	NAS should invest in technology to support a more systematic approach to performance management and continuous improvement to enable full staff engagement.	2.4.11
f	NAS should review its vehicle allocation processes with the aim of reducing the time from call determinant (identification of patient complaint) to vehicle allocation from 100 seconds to 45 seconds (although full achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).	2.5.3
g	NAS should introduce a process for earlier identification of, and dispatch of a vehicle to, Echo (immediately life threatening) calls.	2.5.3
h	NAS should review its vehicle mobilisation processes with the aim of reducing the time from allocation to vehicle mobile from 80 seconds to 45 seconds (although full achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).	2.5.4
i	NAS should undertake a review of all vehicle deployment points in both major and minor urban areas to reduce drive times, aiming for an average drive time of 4 minutes in major urban areas. (See Appendix E for proposed major urban deployment points).	2.5.5

	Recommendation	Section
j	NAS should work in partnership with identified hospitals to reduce the time spent by ambulances at hospital and ensure safe handover of patients.	2.5.8
k	NAS should consider extending the use of Rapid Response Vehicles (RRVs) in both the major urban and minor urban areas.	4.4
l	NAS should consider developing the scope of their network of Community First Responder response to include Delta calls (recognising this will require a major retraining programme), as well as increasing the number of schemes to cover many more areas, thereby improving patient care, clinical outcomes and response times in rural areas.	4.8
m	NAS should introduce a relief ratio of 34% as outlined in the framework in this report.	5.2
n	NAS should give consideration to a programme of work which includes further sensitivity modelling as to the options for providing an Advanced Paramedic to those patients who require it within appropriate timeframes.	5.3
o	NAS should review the number and structure of the dispatch desks, operating processes and the control room staffing arrangements.	7.5
p	NAS should consider setting up a clinical support desk in the control room to offer a Hear and Treat service to appropriate patients.	8.1
q	NAS, in partnership with the wider health system, should review its policy of taking all patients to A&E and consider developing a See and Treat approach.	8.2

2 NAS baseline

2.1 Introduction

In this section, we:

- Review NAS in terms of historical activity, response time performance and call cycle performance
- Look at recent trends and international and UK comparisons to give context
- Make recommendations based on this analysis

This review uses data from nine sources: eight sources provided by NAS covering the period February 2011 - August 2014, and one source supplied by Dublin Fire Brigade (DFB) covering the same period. The large number of NAS data sources reflects the former Health Board regions. NAS has been consolidating CAD (Computer Aided Dispatch) data over the last 3 years into a new single national CAD. There have been challenges for NAS in providing data from disparate systems to provide a solid history.

2.2 NAS's activity in context (benchmarking)

This section reviews the activity of NAS from an international perspective. There are 3 sections covering activity per head of population, growth and geographical call distribution.

2.2.1 Emergency calls per head of population

In Ireland there are a low number of emergency calls per head of population, compared to many other services, particularly in the UK.

Table 2-1 and Table 2-2 below show the number of emergency calls per head of population across different ambulance services. They illustrate the low number of calls that Ireland has per head of population – the number of calls per head in Ireland is less than half of those in England, for example.

Table 2-1: NAS calls per head of population by country and region 2013

	Population	No of emergency calls	Calls per 1,000 population
Ireland* (incl. DFB)[1]	4.5m	320,000	69
Northern Ireland[2]	1.811m	147,707	81

[1] Data provided by NAS & DFB

[2] http://www.niamb.co.uk/docs/our_services_index.html

	Population	No of emergency calls	Calls per 1,000 population
England[3]	53m	9,081,000	171
South West England[4]	5.2m	845,900	162
Scotland[5]	5.29m	850,000	160
New Zealand[6]	4.47m[7]	380,785	85
Western Australia[8]	2.4m	26,966	89

***Note**: Ireland figures contain NAS and DFB Dublin's area.

Table 2-2: Calls per head of population by city 2013

	Population	No of emergency calls	Calls per 1,000 population
County Dublin*	1.2m	121,300	101
London[9]	8.2m[10]	1,712,000	209
Auckland	1.4m	131,400	93
Adelaide	1.3m	146,000	112

***Note**: County Dublin figure contains DFB Dublin's area.

The reasons for the low number of calls per head are not fully understood. There is a risk, therefore, that the factors that underlie this may change over time and that calls per head in Ireland may rise towards UK levels. This would have serious implications for demand for NAS services and is worthy of further study.

[3] http://www.hscic.gov.uk/catalogue/PUB14601/ambu-serv-eng-2013-2014-rep.pdf

[4] http://www.hscic.gov.uk/transparency

[5] http://www.scottishambulance.co.uk/Userfiles/file/Publicinvolvement/SAS%20STRATEGY%202013%2004.pdf

[6]http://www.stjohn.org.nz/Global/Documents/National%20Performance%20Statistics/National_performance_statistics_2012-13.pdf

[7] http://data.worldbank.org/indicator/SP.POP.TOTL

[8] http://eprints.qut.edu.au/46643/1/46643.pdf

[9] http://www.hscic.gov.uk/transparency

[10] http://worldpopulationreview.com/world-cities/london-population/

Recommendation

NAS should undertake further investigation into why emergency calls per head are so low in Ireland compared to England, so that future patterns of growth in Ireland can be better understood and accommodated.

2.2.2 Growth in emergency incidents

This section examines the growth rate of NAS emergency incidents compared with other ambulance services. NAS has had a growth of around 6.5% over the three year period 2011 – 2013, which is broadly in line with growth in the UK and is similar to patterns seen elsewhere.

Interestingly, Dublin Fire Brigade (DFB) which provides the emergency response in most of Dublin has seen growth of only 1% during the same period.

The population growth in Ireland over the last three years has been 0.2%[11], and so demand for ambulance services is increasing considerably faster than population growth. This is in line with experiences of UK ambulance services and other services round the world.

2.2.3 Geography and population– urban and rural split

The population density and distribution in Ireland is significantly different to that of many other countries. With the exception of Dublin (which represents around 1.2 million of a total 4.5 million), the population is widely dispersed around the country with a relatively large proportion living in rural areas: it does not have large uninhabited areas where people have not settled.

In contrast, Scotland, for example, is a country with areas of relatively uninhabited countryside with the bulk of the population living in a number of urban areas.

Table 2-3 below shows that as a result of the distribution of the population, Ireland has a far higher percentage of activity in rural areas than other ambulance services. Most services have 70- 90% of their activity in urban areas. In NAS it accounts for only 60%. Rural areas normally account for between 10 – 30% compared with 40% in NAS.

Table 2-3: % Emergency activity - urban / rural split by ambulance service

Service	Urban	Rural
NAS (excluding DFB activity)	60%	40%
South East Coast	85%	15%
South Western	74%	25%
East of England	72%	28%
Scotland*	80%	20%

[11] See http://data.worldbank.org/indicator/SP.POP.GROW

*** Note**: Scottish figure estimated based on national population statistics.

As we show in Section 2.3.3, this urban/rural split has major implications for NAS and its ability to achieve the same response time standards as more urban services.

2.2.4 Summary of NAS activity in context

Compared to other services, NAS has:

- A low number of emergency calls per head of population
- Growth rates in emergency calls that are broadly in line with growth elsewhere
- A very large percentage of calls originating in rural areas

2.3 Ireland's local activity

This section reviews the makeup of NAS activity and the growth patterns. NAS activity is made up of three types of incident:

- Emergency calls – Calls that come in on the 999 lines
- Urgent calls – Typically calls from GP surgeries that require an urgent response
- Routine calls – Pre-booked hospital journeys and transfers

2.3.1 NAS activity

This section reviews the daily activity by incident type and geographical area. NAS handles around 700 incidents a day as seen in Figure 2-1, which shows the total daily incidents over the last 3 months.

Figure 2-1: NAS total incidents per day

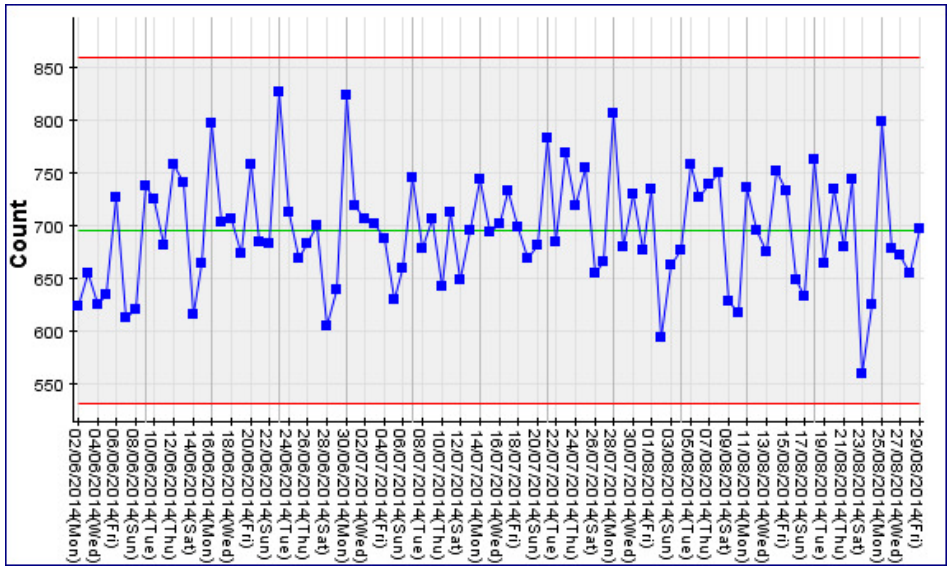
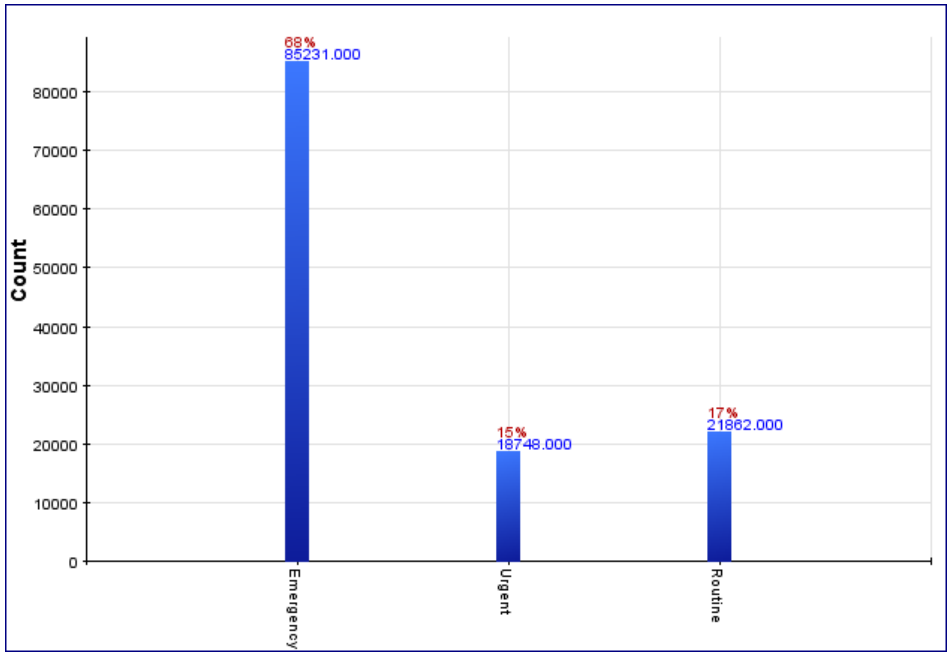


Figure 2-2 below shows the relative volumes of these different types of incident. As can be seen, emergency incidents account for 68% of all incidents, urgent for 15% and routine for 17%.

Figure 2-2: Breakdown by incident type



NAS emergency incidents

NAS handles around 480 emergency incidents a day as seen in Figure 2-3, which shows the total daily emergency incidents over the last 3 months – (June / August 2014 data)

Figure 2-3: Emergency daily average no of incidents for NAS activity

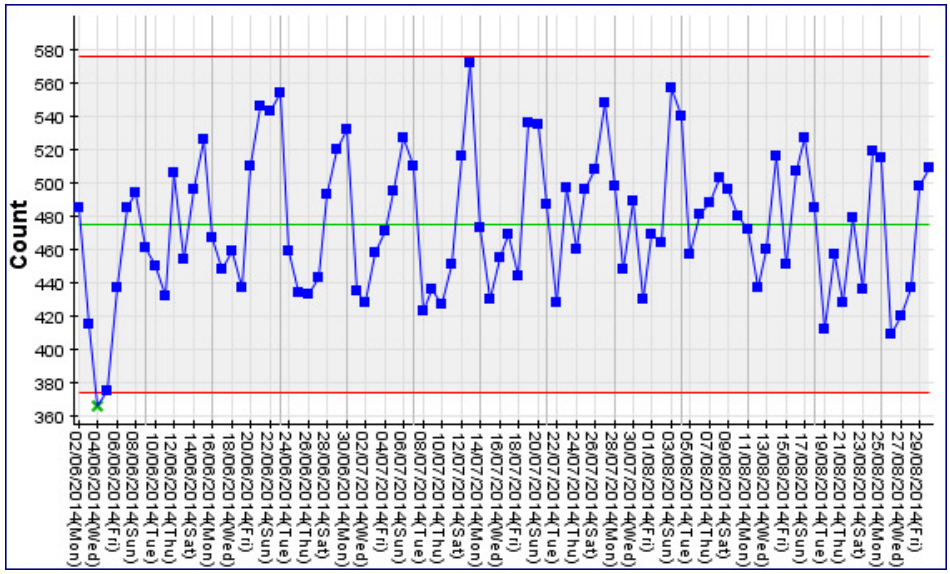


Figure 2-4: NAS no of emergency incidents by drive zones

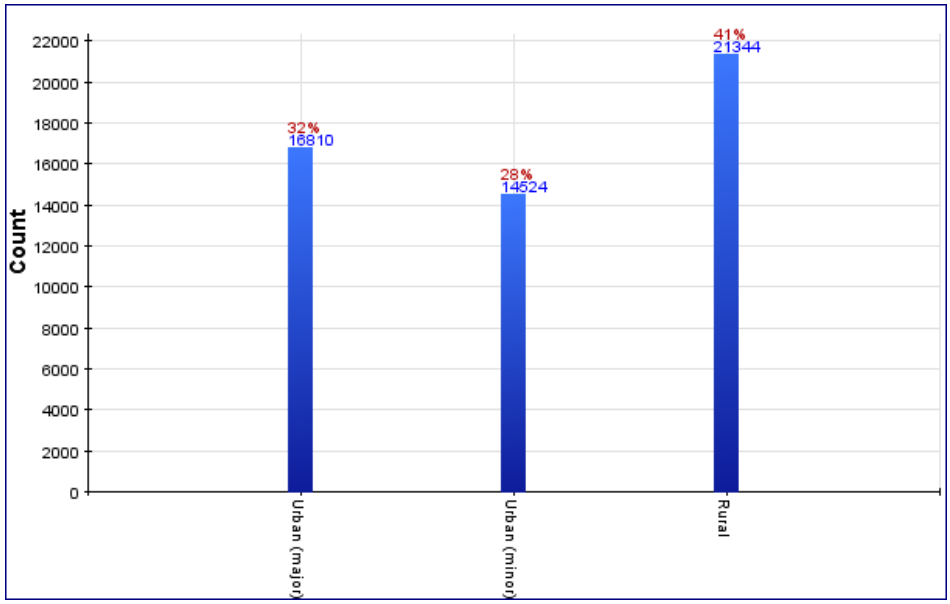
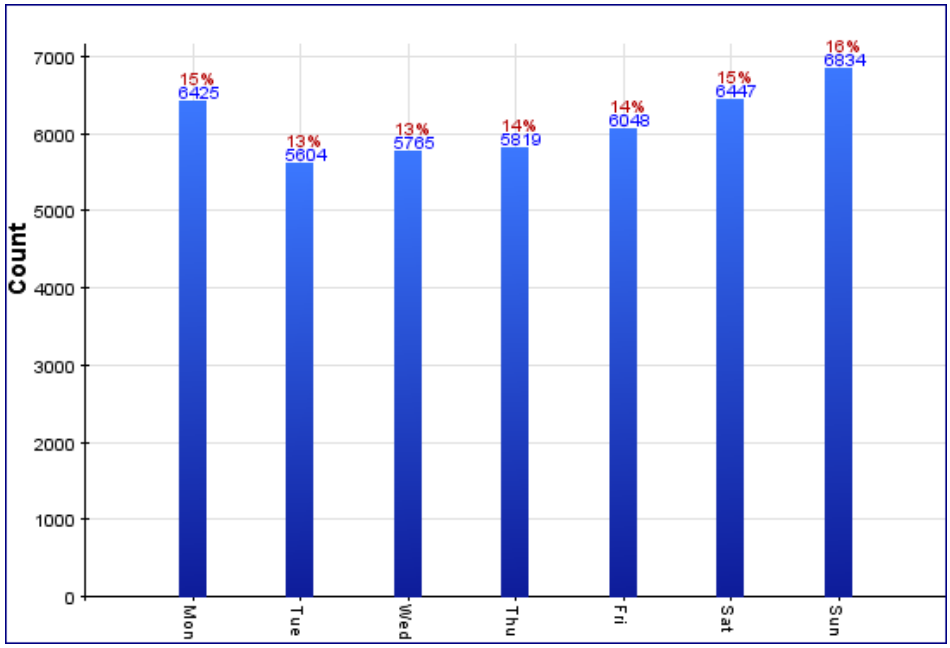


Figure 2-5 shows the number of emergency incidents by day of the week over a 3 month period. It shows a greater number of incidents at the weekends, which is the normal pattern often seen in ambulance services. Saturday and Sunday have around an extra 3% increase in volume, with the lowest volume of the week on the Tuesday.

Figure 2-5: NAS total emergency verified incidents by day of the week



NAS urgent incidents

NAS handles around 100 urgent incidents a day as seen in Figure 2-6, which shows the total daily incidents over the last 3 months

Figure 2-6: NAS total urgent verified incidents by day of the week

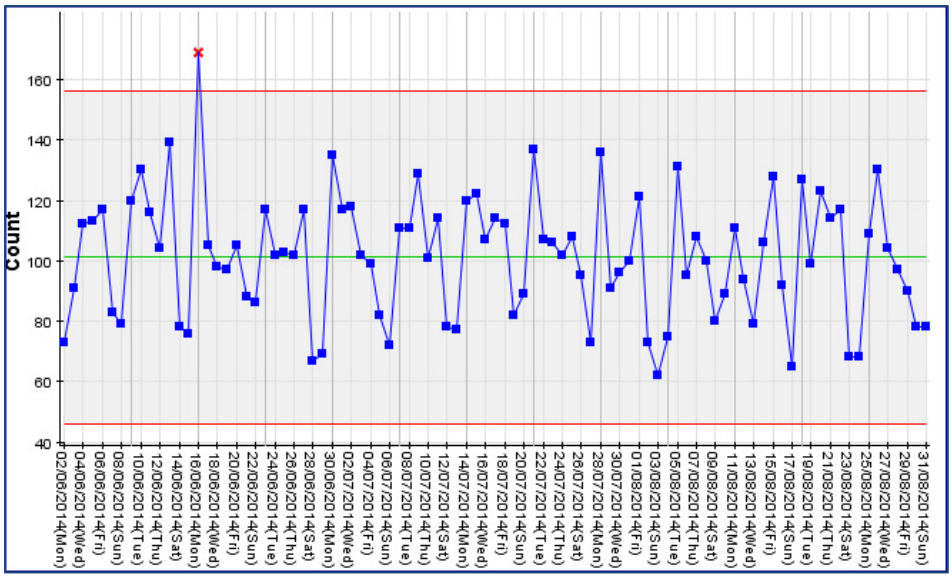
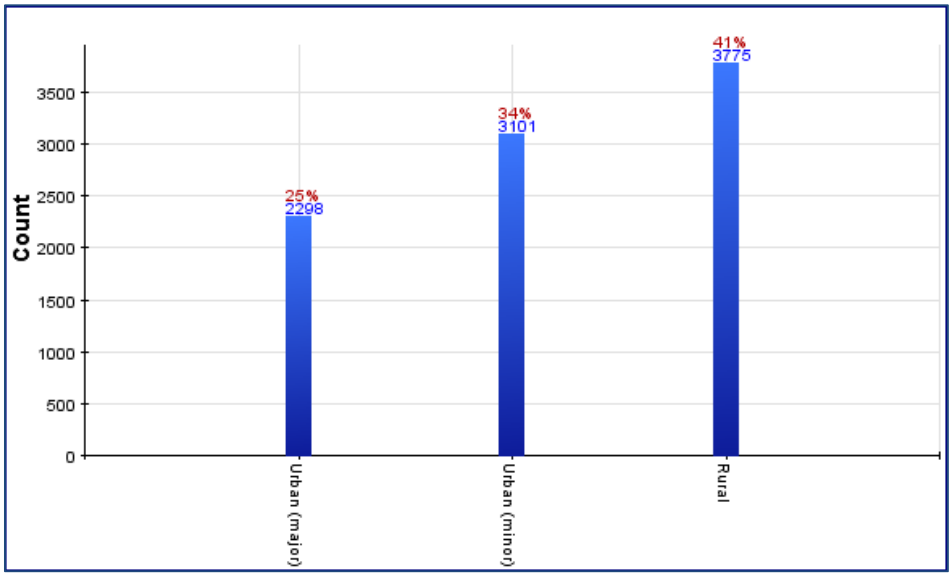


Figure 2-7 shows NAS urgent incidents over the last 3 months split by drive zone. It shows 41% of the incidents occur in rural areas.

Figure 2-7: NAS total urgent verified incidents by drive zones



NAS routine incidents

NAS handles around 120 routine incidents a day as seen in Figure 2-8, which shows the total daily emergency over the last 3 months. It shows that the service operates at about a third of the activity at the weekend.

Figure 2-8: NAS total routine verified incidents by day of the week

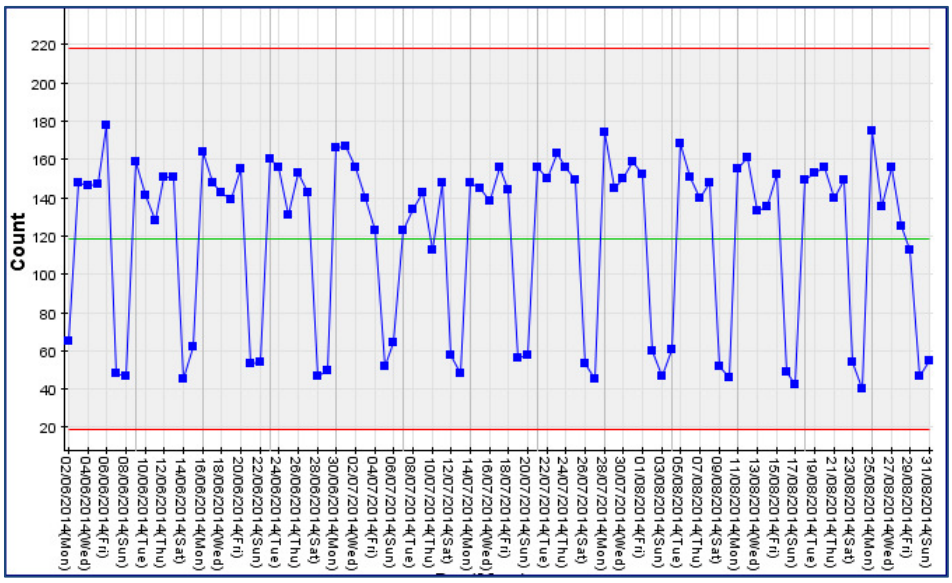
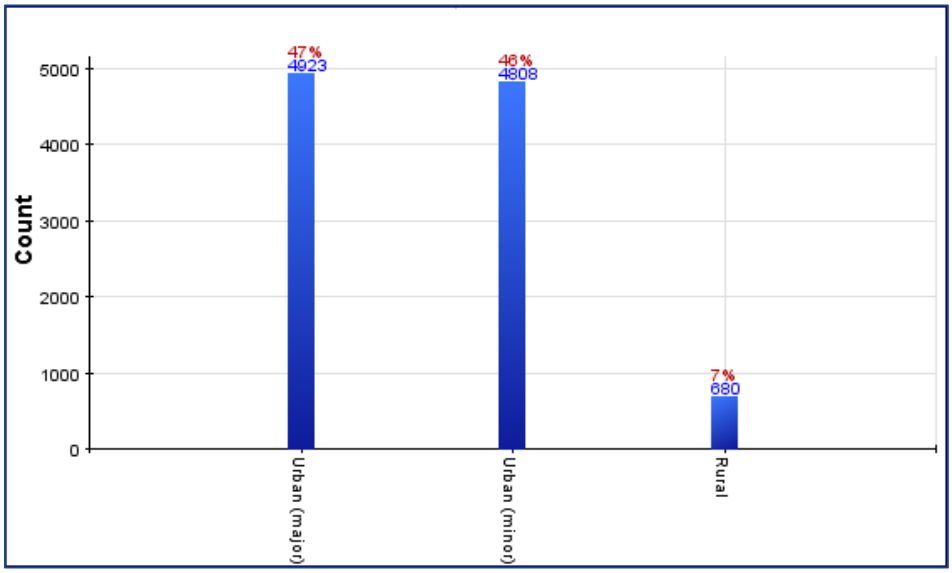


Figure 2-9 shows NAS routine incidents from over the last 3 months split by drive zone. It shows 93% of the incidents occur in urban areas.

Figure 2-9: NAS total routine verified incidents by drive zones

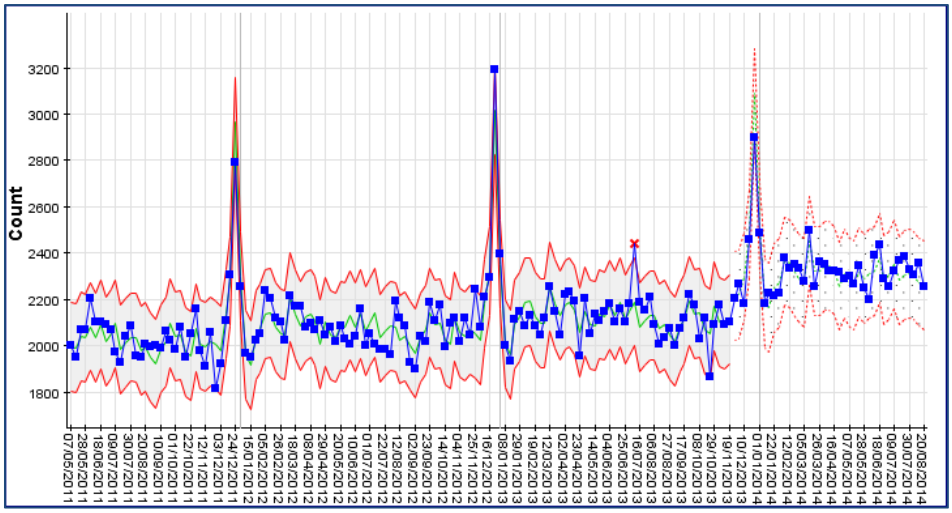


2.3.2 NAS historic activity growth

NAS has a number of data sources left over from the former health boards. Not all areas have historical data as some processes were originally paper based. These charts use weekly average to show seasonality over time.

Figure 2-10 demonstrates the growth based on a proportion of stable NAS data. It shows consistent growth of 1.9% across all levels of incident.

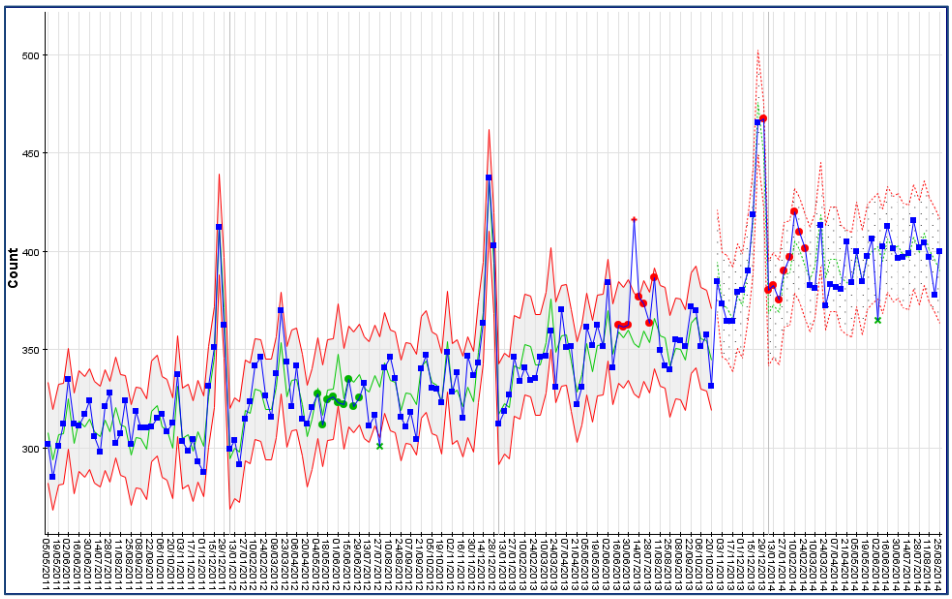
Figure 2-10: Incident growth based on stable data sources



NAS emergency growth

Figure 2-11 demonstrates the growth of emergency incidents based on a number of NAS areas. It shows consistent growth of 6.5% per annum.

Figure 2-11: Emergency incident growth based on stable data sources

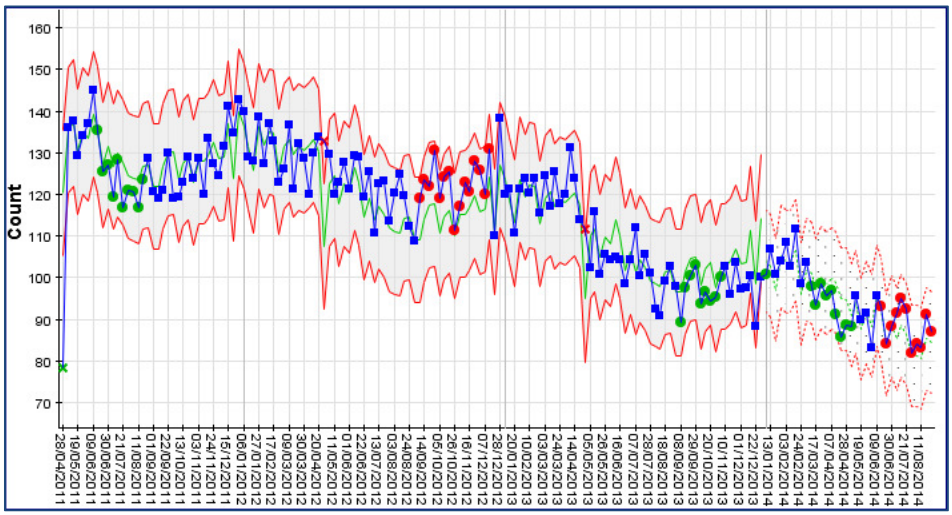


NAS urgent growth

Urgent activity has been declining in volume at a rate of 10% per year over the last 3 years. Urgent activity in 2014 accounts for around 100 incidents a day or 700 a week. This load is fairly evenly spread across the working days of the week, but there are around 30% fewer incidents on the Saturday and Sunday than Monday to Friday.

Since the beginning of 2014 the number of urgent incidents has stabilised.

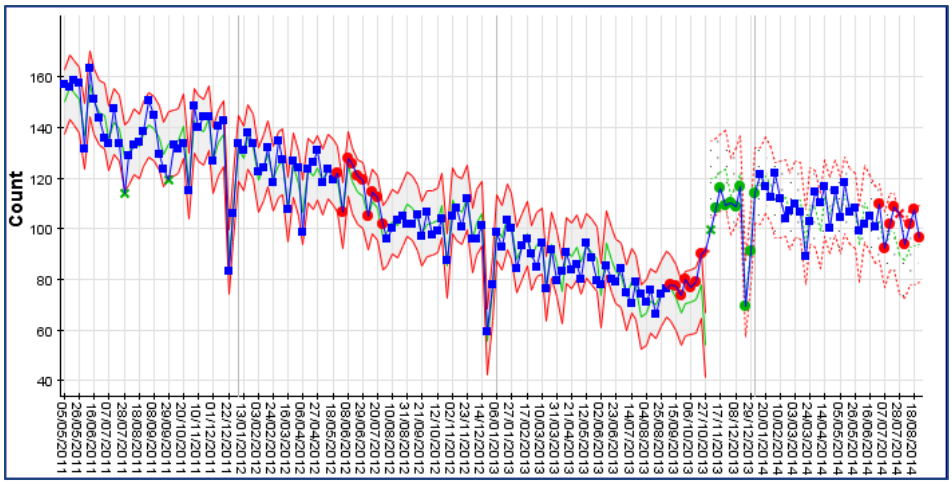
Figure 2-12: Urgent incidents based on stable data sources



NAS routine growth

As Figure 2-13 shows, the trends in routine activity are quite striking. From April 11, routine activity handled by NAS fell as hospitals increasingly stopped using NAS for this type of work, turning to private providers instead, as pressures of emergency demand made it harder for NAS to handle the more routine inter hospital transfer work.

Figure 2-13: Number of routine incidents based on stable data sources

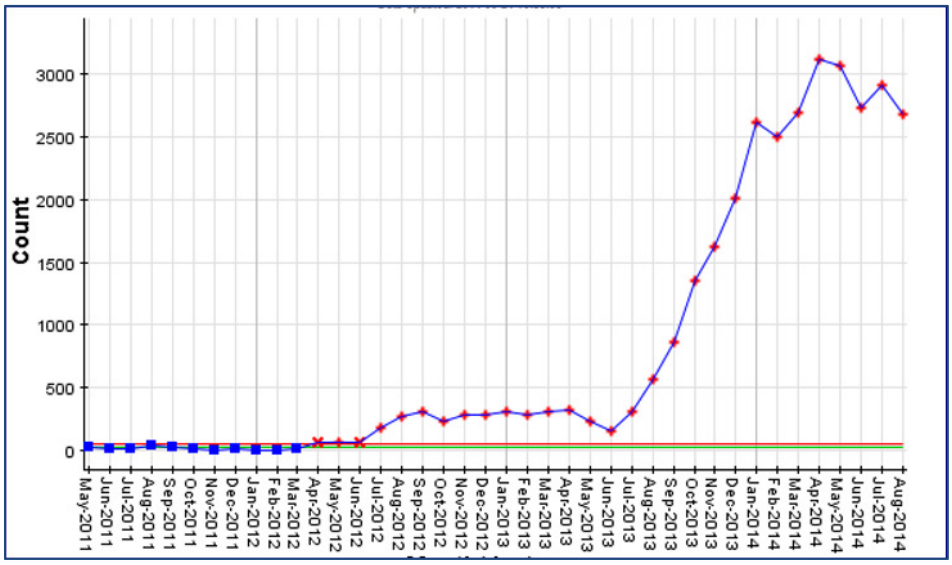


In November 2013, NAS began introducing intermediate care vehicles (ICVs) to transport lower acuity work and reduce the pressure on the emergency fleet. Almost immediately the trend in routine work reversed, as hospitals grew increasingly confident in NAS, and reduced their reliance on using the private providers. As NAS increased the number of ICVs, demand continued to rise until stabilising at around 120 incidents per day. However, this is still some 15% below the peak, suggesting that not all demand has returned to NAS.

It should be better value for the Irish health system to have NAS doing this work rather than private providers. There would appear to be scope for NAS to work with partners to handle this work on a planned and agreed basis, to bring additional income to NAS and bring savings to partners.

Figure 2-14 shows the number of responses by Intermediate Care Vehicles (ICVs). It shows the introduction of the ICV pilot and the growth of the ICV responses, currently running at around 100 jobs a day. This is a real success story and the extra work undertaken by the ICV fleet has not only improved NAS 19 minute response times but also enabled hospitals to reduce their reliance on private providers to transport patients.

Figure 2-14: Responses by ICVs



Our analysis suggests there is scope to introduce extra ICV resource to handle routine inter hospital transfers, further reducing the pressure on the emergency fleet. In three areas further investment could usefully be made in ICV's – Dublin (one vehicle), Waterford (two vehicles), and the Midlands (one vehicle). Cover should be from 10.00 to 20.00 Monday to Friday. (See Table 4.3 in Section 4.7)

Recommendation

NAS should work with partners in the Irish health system to establish an agreed basis for handling routine activity (inter-hospital transfers of patients) with improved utilisation of ICVs.

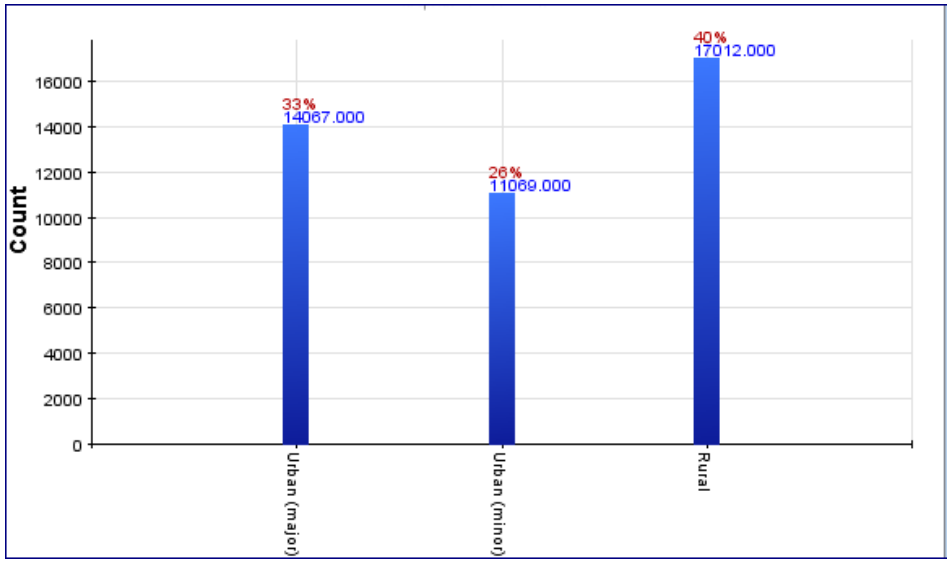
2.3.3 NAS activity by geography

A key factor when planning deployment points and response models to meet the 8 minute and 19 minute response time targets is the call frequency by geographic area. To support this we use the following criteria in modelling drive zones by area:

- Major urban areas receive 6 or more emergency or urgent incidents per 24 hour period within a deployment area bounded by a 6-minute drive time (based at normal travel speeds) which equates to an area with a 5 kilometre radius
- Minor urban areas receive 1-6 emergency or urgent incidents per 24 hour period within a 6-minute drive time
- Rural areas receive fewer than 1 emergency incident per 24 hour period within any 6-minute drive time

In Ireland, the major urban areas account for 33% of emergency incidents and the minor urban for 26% with the rural areas accounting for 40%, as shown in Figure 2-15.

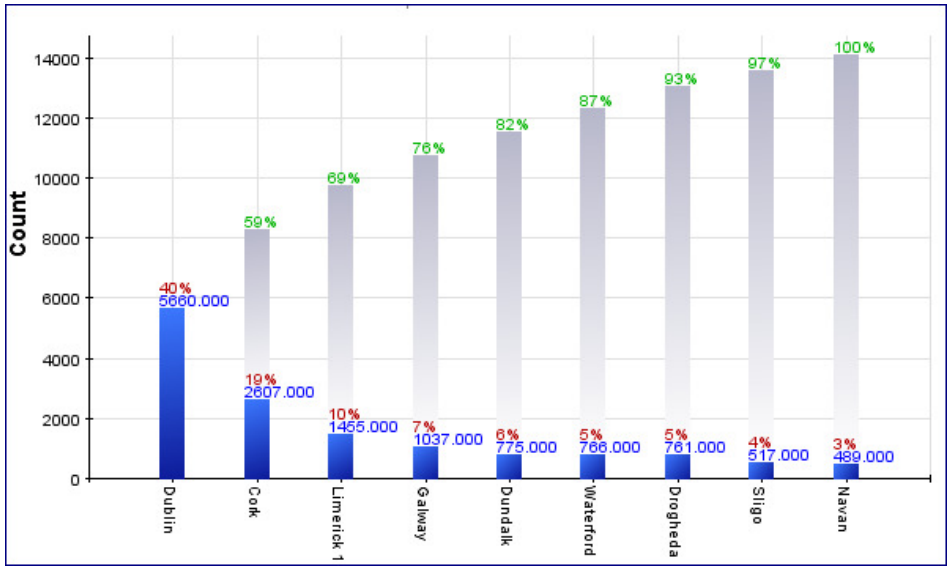
Figure 2-15: Proportion of emergency incidents by drive zone



NAS major urban areas

These are areas of a 5km radius that have 6 or more emergency incidents per day. These areas cover the nine major towns across Ireland: Dublin, Cork, Limerick, Galway, Dundalk, Waterford, Drogheda, Sligo and Navan.

Figure 2-16: Number of emergency incidents in the 9 major urban areas



NAS minor urban areas

Minor urban areas are areas of a 5km radius that have 1-5 emergency incidents per day. These areas cover 55 minor towns across Ireland, and account for 26% of NAS demand. This is a significantly larger proportion than most ambulance services, which typically have 7-12% of the incidents in this type of area.

The red and blue flags in the map below show the number of incidents in each minor urban area. The minor urban areas are spread across the country, increasing the challenge.

Figure 2-17: Map of minor urban areas

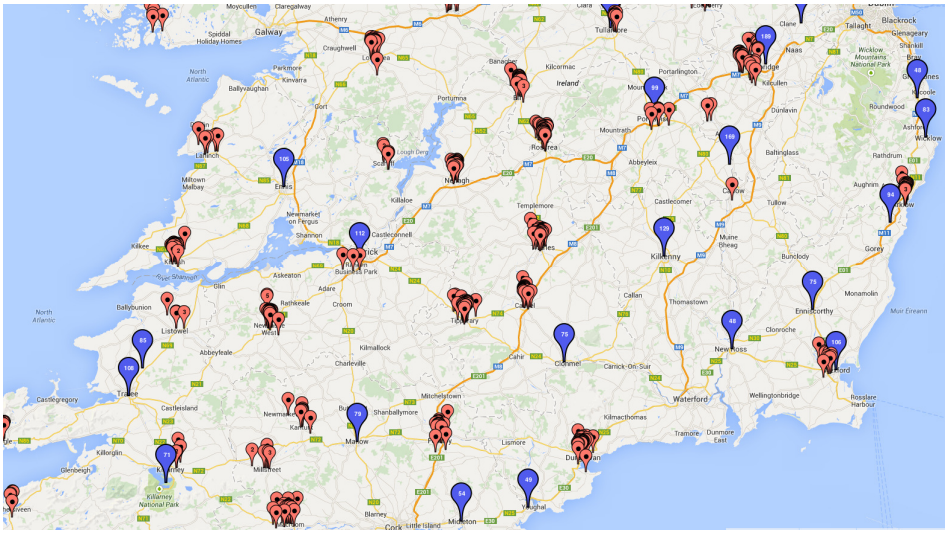


Table 2-4 lists the minor urban areas.

Table 2-4: Minor urban zones

Minor urban locations			
Letterkenny	Mallow	Ballina	Edenderry
Naas	Tullamore	Carrick-on-Shannon	Ballyshannon
Kilkenny	Monaghan	Gorey	Fermoy
Wexford	Arklow	Thurles	Carndonagh
Carlow	Longford	New Ross	Bantry
Newbridge	Enniscorthy	Tipperary	Cashel
Tralee	Maynooth	Stranorlar	Listowel
Swords	Wicklow	Nenagh	Clonakilty
Clonmel	Killarney	Youghal	Roscrea
Mullingar	Castlebar	Ardee	Dunshaughlin
Ennis	Roscommon	Newcastle	Loughrea
Athlone	Athy	Castleblayney	Kilrush
Cavan	Dungarvan	Ballinasloe	Newcastle West
Portlaoise	Midleton	Donegal	

NAS rural areas

These are areas of a 5km radius that have fewer than 1 emergency incident per day. These areas cover the rest of the country and account for 40% of NAS activity.

2.3.4 Activity summary

NAS has seen underlying growth in emergency demand of 6.5% per year from 2010 to 2013. Over the same period, growth in DFB emergency demand has been only around 1%. NAS urgent and routine demand have now both stabilised following a period of variation.

40% of NAS activity originates in rural areas, which is high compared to services in the UK. Overall activity is around 700 total incidents a day, which is made up of 480 emergency Incidents and 100 urgent and 120 routine. DFB in addition handles around 210 emergency incidents in central Dublin.

2.4 Performance

2.4.1 NAS response time performance

The primary purpose of the 8 minute target for Echo and Delta incidents is to provide commencement of care as quickly as possible to patients with life threatening (Echo) or potentially life threatening (Delta) conditions. NAS has two performance standards for response times:

- **8 minute standard** – 8 minutes from identifying final determinant to the arrival at scene of any NAS resource (including community first responders) for Echo and Delta calls – **Target = 80%**
- **19 minute standard** – 19 minutes from final determinant to arrival at scene of NAS transporting vehicle for Echo and Delta calls – **Target = 95%**

These targets are more stretching than those for Scotland and England (which are 75% for the 8 minute standard and 95% for the 19 minute standard) and for Wales (60% in 8 minutes).

Currently NAS has only one formal clinical outcome performance indicator (Return of Spontaneous Circulation). In our view, this results in too much concentration on simple response time performance. There is scope to develop measures that cover clinical outcomes and patient experience and which better integrate with the wider health system.

Recommendation

NAS should build on the HIQA National Standards for Safer Better Healthcare[12] and develop a suite of appropriate clinical outcome and patient experience measures.

Over the years, Lightfoot has developed a capacity model for use in ambulance services that enables us to assess the ability of an ambulance service to achieve response time performance standards taking into account a range of contributing factors such as geography, population, transport, road and health infrastructures and the level of resources available. Based on our experience of applying the model in various parts of the world, we can estimate the best performance an ambulance service

[12] http://www.hiqa.ie/stndards/health/safer-better-healthcare

could be expected to achieve if it were fully resourced and its operating processes were meeting best international standards.

The key factor in estimating a service's potential ability to deliver performance is the call frequency by geographical area, based on categorising ambulance activity into major urban, minor urban and rural areas. This approach is considered in more detail in Section 2.3.3. From our experience of working with other services, we know that the best results that can be consistently achieved for the 8 minute standard are:

- 85% in major urban areas
- 75% in minor urban areas
- 40% in rural areas

This means that, if we know the proportion of calls originating in the different areas, we can estimate the best achievable performance of the service if it is fully resourced and operating to best standards. Below are two tables assessing the best achievable performance against the 8 minute target for NAS and for a typical ambulance service in England.

The percentage of activity multiplied by best achievable performance gives the contribution to total performance. For further explanation see Appendix C.

Table 2-5: Best achievable performance against the 8 minute standard

	% of NAS activity	Best achievable performance	Contribution to total performance
Major urban	28%	85%	24%
Minor urban	32%	75%	24%
Rural	40%	32.9%	12.6%
Total	100%		**60.6%** (Current NAS target = 80 %.)

Table 2-6: Best achievable performance against the 8 minute standard, for a typical ambulance service in England

	% of activity	Best achievable performance	Contribution to total performance
Major urban	81%	85%	69%
Minor urban	7%	75%	5%
Rural	12%	40%	5%
Total	100%		**79%** (Current target for ambulance services in England =75%)

Table 2-5 and Table 2-6 demonstrate the very large impact that Ireland's highly rural population has on the ability of NAS to achieve the same response time performance as a typical English ambulance service. The best that NAS can be expected to achieve is 60.6%, compared to 79% for a typical English service. This is due to the fact that our modelling indicates that NAS will not be able to practically raise the rural performance above 32.9%, due to the significantly high amount of rural activity. Table 2-5 also shows that the external targets set for the NAS are completely unachievable.

Recommendation

NAS should consider consulting with HIQA on a review of response time targets, in the light of the conclusions of this report about their achievability.

2.4.2 NAS Echo and Delta 8 minute performance

Having considered what NAS could achieve given full resources and best operating practices, we now go on to look at NAS current performance.

Figure 2-18 below shows Echo and Delta 8 minute performance. It shows an average 27% performance with a fairly large degree of variation and no particular trend. Last winter was a particularly poor performance period.

Figure 2-18: NAS 8 minute Echo and Delta performance

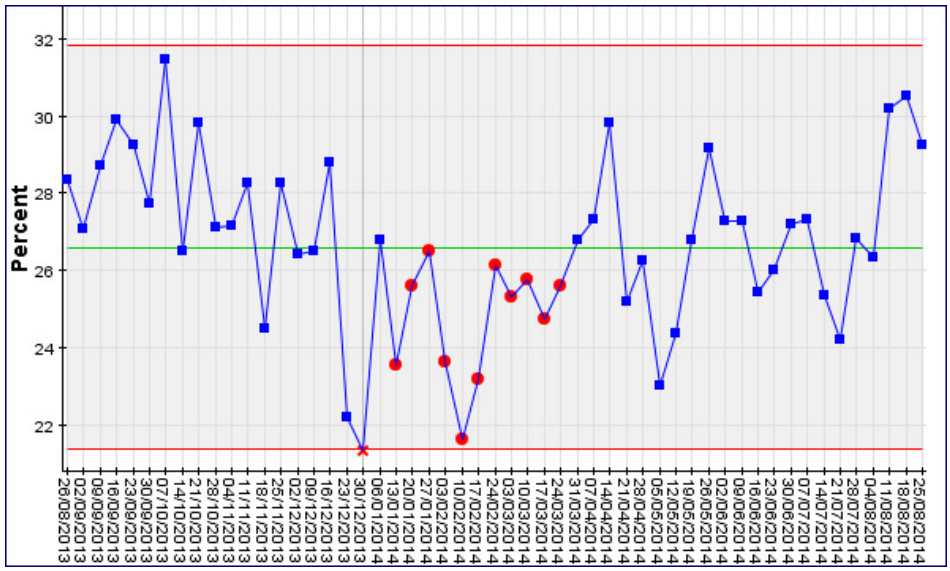
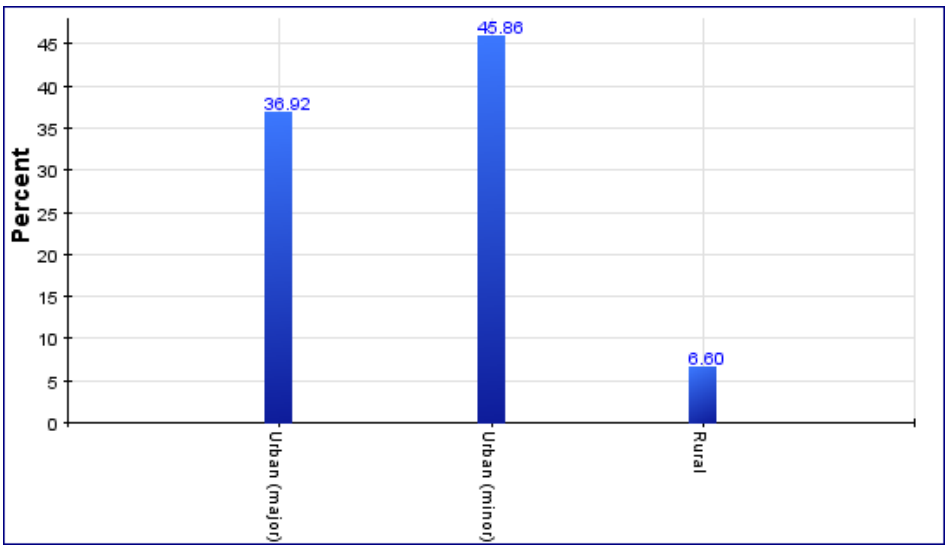


Figure 2-19 below shows Echo and Delta 8 minute performance by major urban, minor urban and rural geographical areas. The major urban area has performed at 37% and the minor urban at 45% and the rural at 6.6%. It is very unusual for major urban areas to have lower performance than minor urban

areas. NAS performance is clearly well below best practice of 85% in major urban, 75% in minor urban and 40% in rural areas. Solutions to these challenges are considered in more detail in Section 4.

Figure 2-19: NAS 8 minute Echo and Delta performance by drive zones



2.4.3 NAS Echo and Delta 19 minute performance

Figure 2-20 shows the NAS 19 minute Echo and Delta performance for NAS. The chart shows an upward trend in performance from 64% to 67% in a year. Much of the improvement can be attributed to the introduction of Intermediate Care Vehicles (ICVs) which reduced the workload on the emergency fleet. This demonstrates the benefits of this investment and is a very encouraging improvement.

Figure 2-20: NAS 19 minute Echo and Delta performance

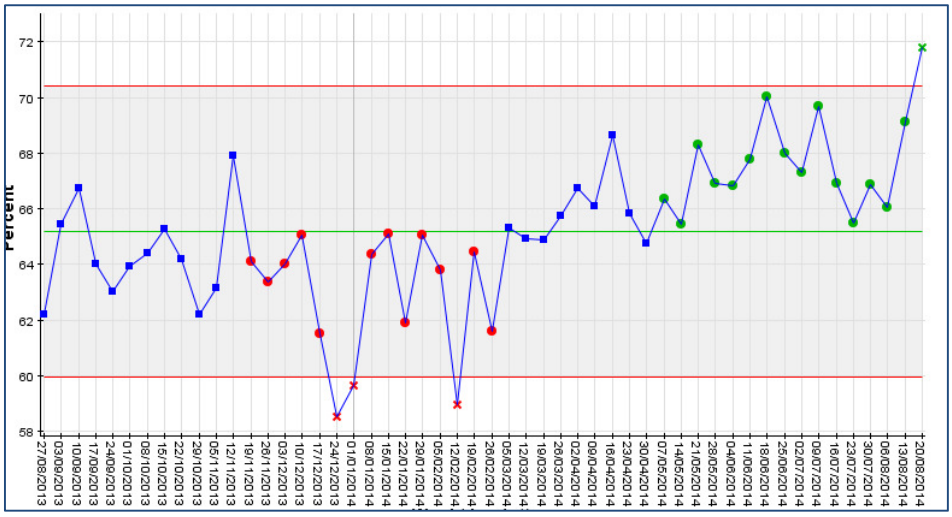
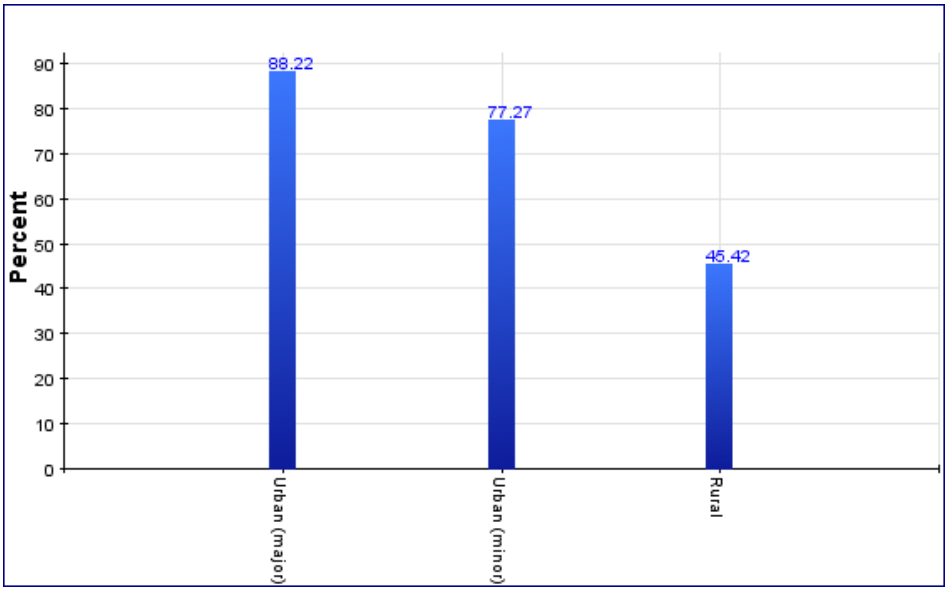


Figure 2-21 shows the NAS 19 minute Echo and Delta performance in the three months from June 2014. The major urban performance for 19 minutes is 88%, minor urban is 77% and rural is 45%. Best

practise in the UK is 95%. There is therefore clearly scope for improvement and this is considered in more detail in Section 4.7 below.

Figure 2-21: NAS 19 minute Echo and Delta performance by drive zones



2.4.4 Bravo and Charlie performance

19 minute Bravo and Charlie performance

Figure 2-22 shows NAS 19 minute performance for Bravo and Charlie incidents. This chart shows that NAS achieved a material improvement in 19 minute performance over the year to August 2014, with performance improving from 60% in August 2013 to over 65% in August 2014. This improvement is due to the introduction of ICVs.

Figure 2-22: NAS 19 minute Bravo and Charlie performance

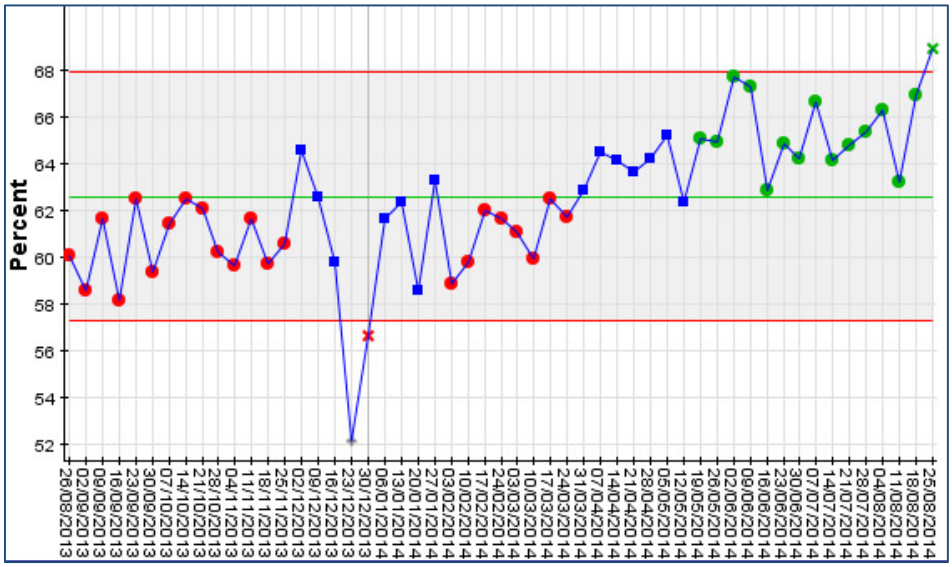
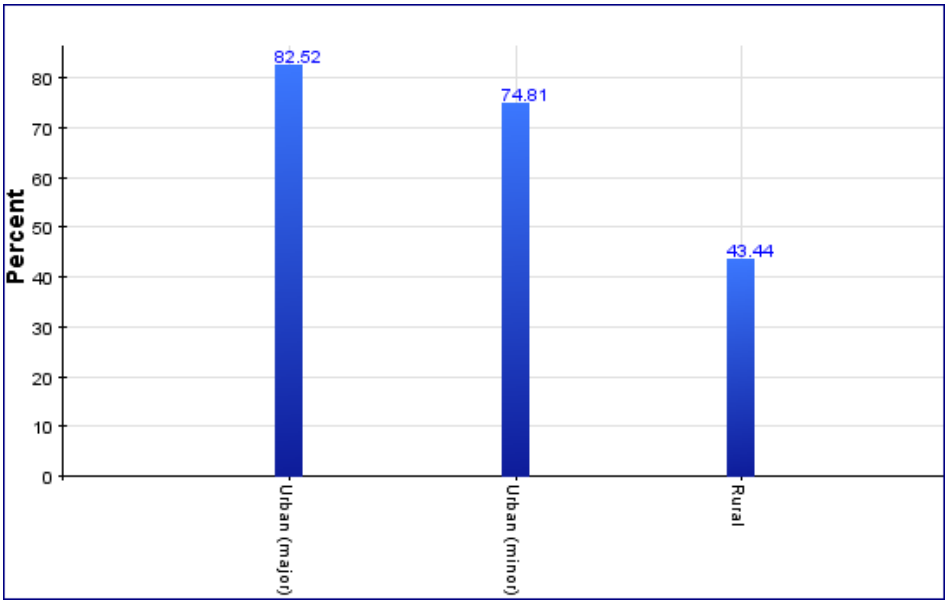


Figure 2-23 shows NAS 19 minute performance for Bravo and Charlie incidents by drive zones in the three months from June to August 2014. This shows that major urban 19 minute performance is 83% and minor urban 75%. Rural performance is 43%.

Figure 2-23: NAS 19 minute Bravo and Charlie performance by drive zones



2.4.5 Alpha and Omega performance

60 minute Alpha and Omega performance

Figure 2-24 shows NAS 60 minute performance for Alpha and Omega incidents in the year to August 2014. This chart shows that the average performance has improved from 92% in August 2013 to over 97% since the introduction of ICVs.

Figure 2-24: NAS 60 minute calls, Alpha and Omega performance

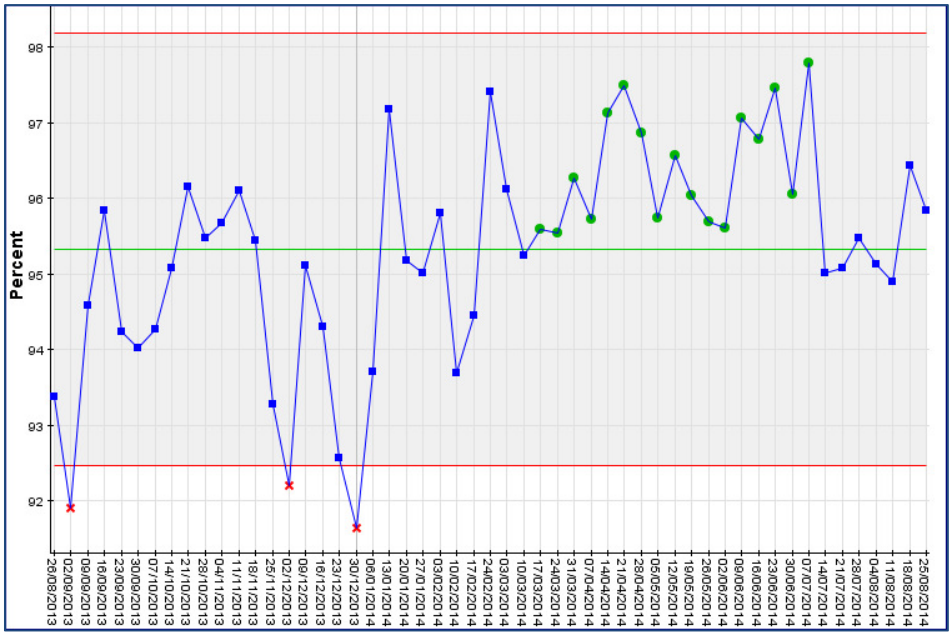
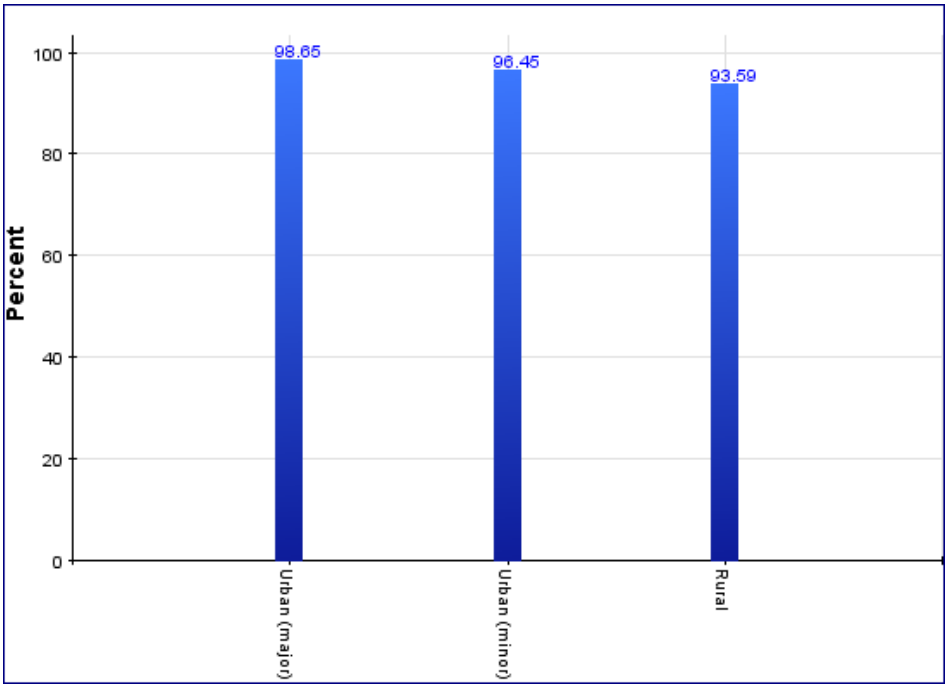


Figure 2-26 shows NAS 60 minute performance for Alpha and Omega incidents by drive zone in the three months between June and August 2014. This shows that performance in the period was 99% in major urban areas and 96% in minor urban areas.

Figure 2-25: NAS 60 minute calls, Alpha and Omega performance by drive zone



2.4.6 NAS Echo and Delta major urban performance

Reviewing the performance for major urban incidents helps us to understand where the focus of performance improvement should be placed.

Major urban 8 minute performance

Figure 2-26 shows the NAS Echo and Delta 8 minute performance for major urban areas over time. The average performance is 37% with a range of 28%-46%. This is well below the performance that many other services achieve in major urban areas of 85% and is also much more variable.

Figure 2-26: NAS 8 minute major urban Echo and Delta performance

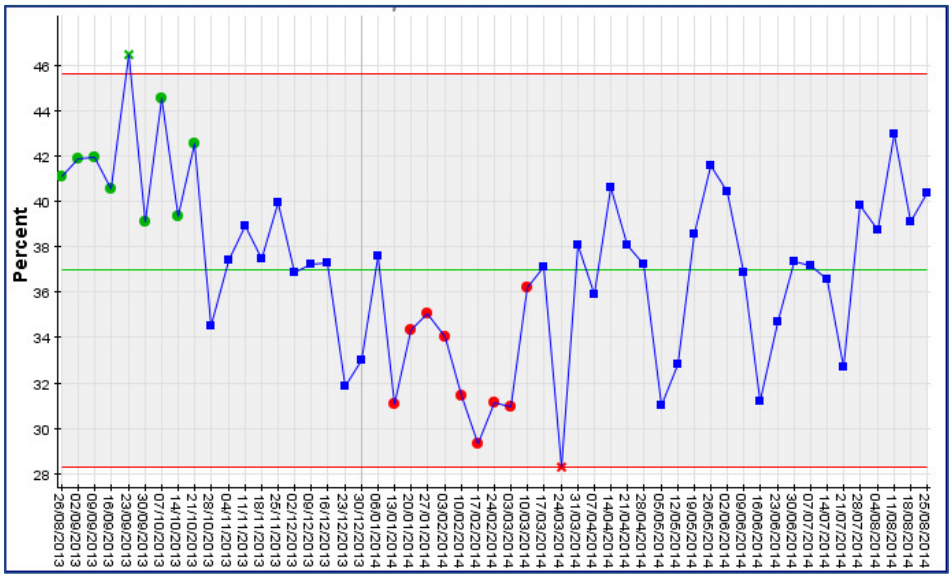
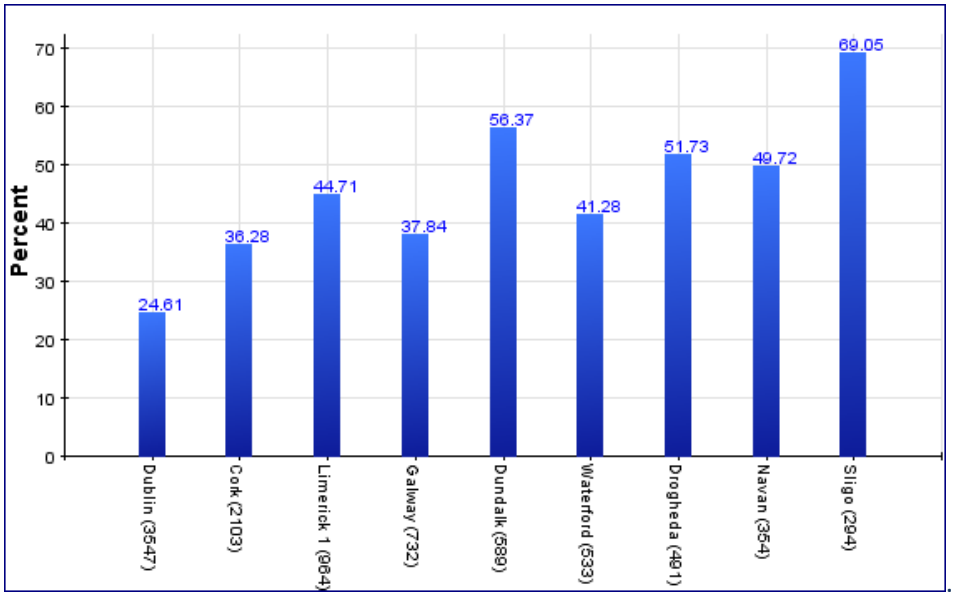


Figure 2-27 shows NAS 8 minute performance for Echo and Delta incidents, by major urban location. The left hand side of the chart has the highest number of incidents and the right the lowest. Dublin, the busiest area, performs the lowest at 24% and Cork follows at 36%.

Figure 2-27: NAS major urban performance by location



Major urban 19 minute performance

Figure 2-28 shows an average performance of 85% over the last 12 months for 19 minute Echo and Delta incidents. Performance dropped off in January and February but there has been a noticeable improvement since May 2014. As noted above, the introduction of ICVs was key to this improvement.

Figure 2-28: NAS major urban Echo and Delta 19 minute performance

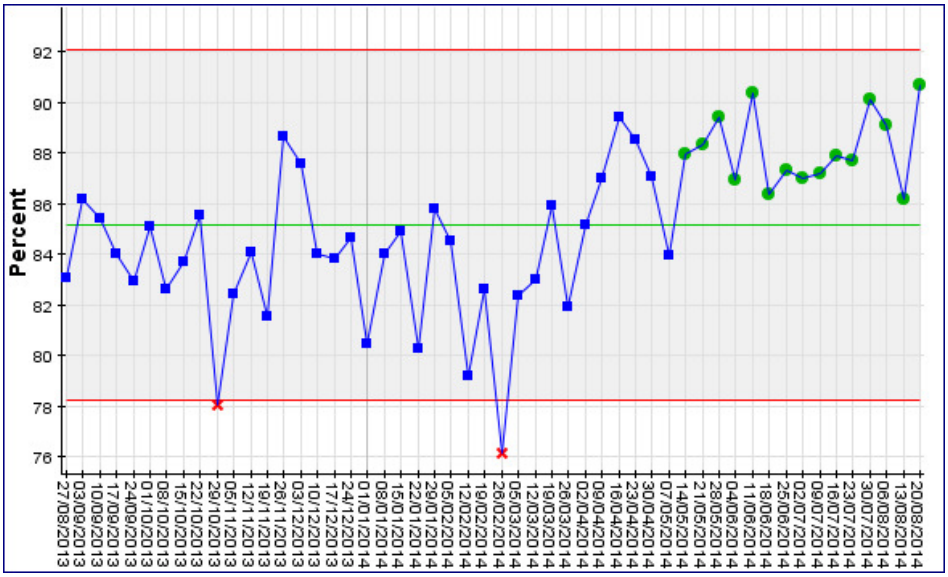
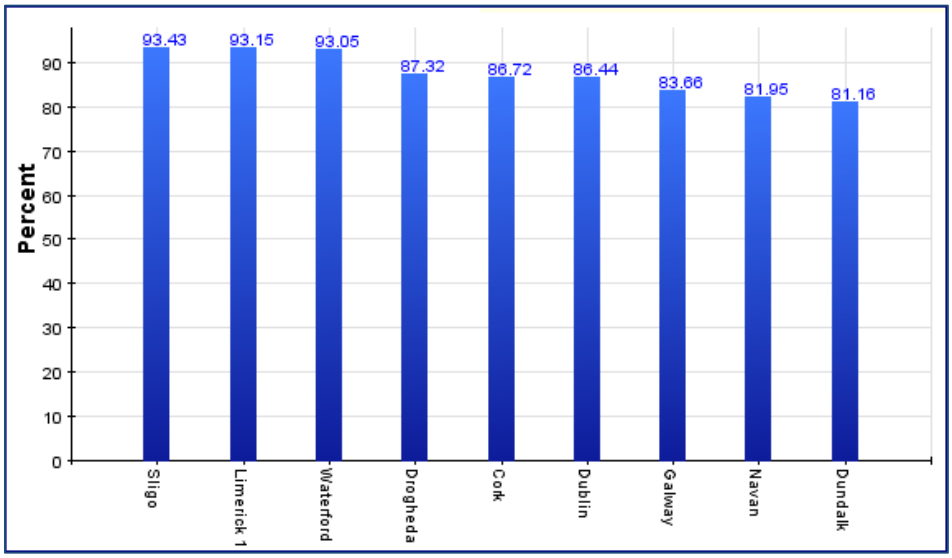


Figure 2-29 shows an average performance by drive zone for the major urban areas. The performance for 19 minutes at scene with transport is between 81 - 94%.

Figure 2-29: NAS major urban Echo and Delta 19 minute performance by drive zone



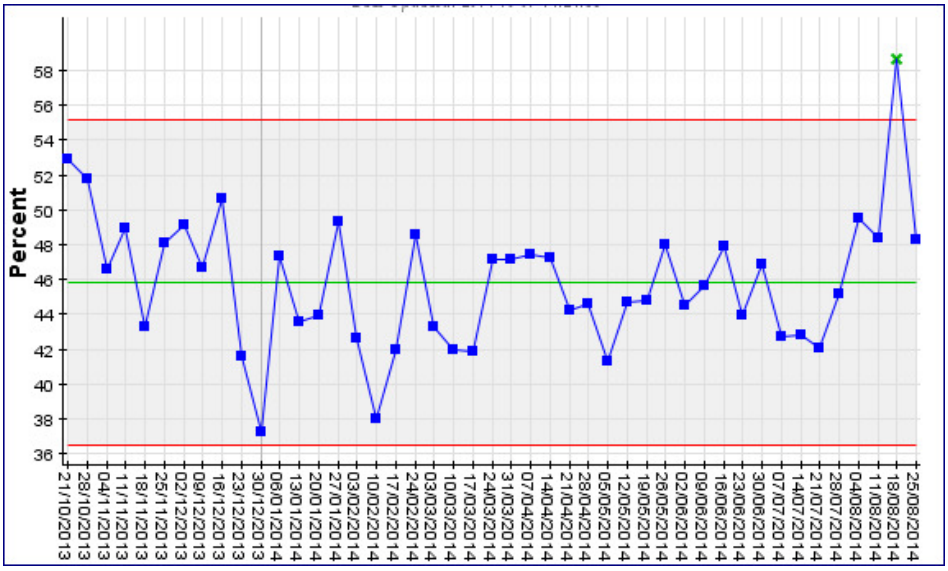
2.4.7 NAS Echo and Delta minor urban performance

There are 55 locations where there are 1 -5 incidents a day within a 5km radius circle.

Minor urban 8 minute performance

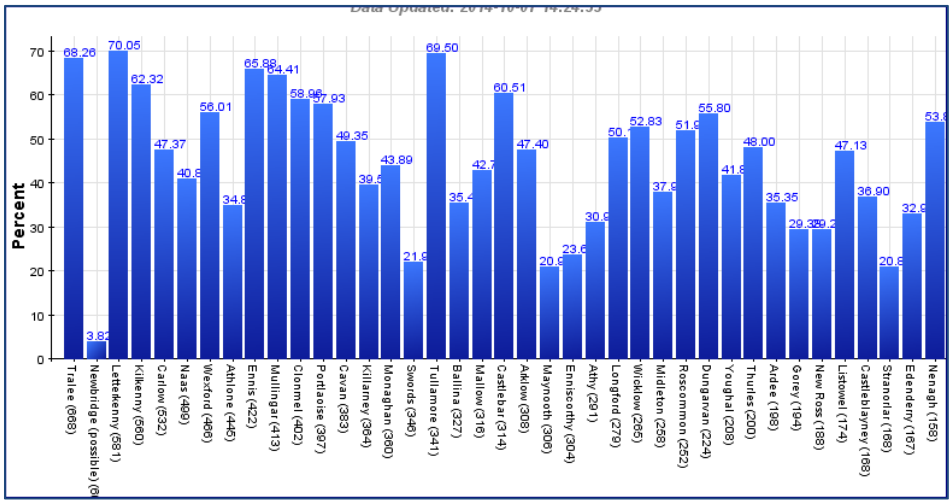
Reviewing the performance for minor urban incidents helps us to understand where the focus should be. Echo and Delta average performance has been around 46%. Fully resourced and with best operating practices, these areas should be performing at 75% in 8 minutes.

Figure 2-30: NAS minor urban Echo and Delta 8 minute performance



Performance for minor urban incidents for Echo and Delta can also be reviewed by individual towns. Figure 2-31 shows there is a wide range of performance across the 55 locations: whilst both Tralee and Letterkenny perform at over 68%, performance in Newbridge (where NAS currently has no ambulance station) is only 3%.

Figure 2-31: NAS minor urban Echo and Delta 8 minute performance



Minor urban 19 minute performance

19 minute performance for minor urban incidents for Echo and Delta shows that the performance for autumn / winter 2013 had an average performance of 72%. Since then performance has improved to 77%.

Figure 2-32: NAS minor urban Echo and Delta 19 minute performance

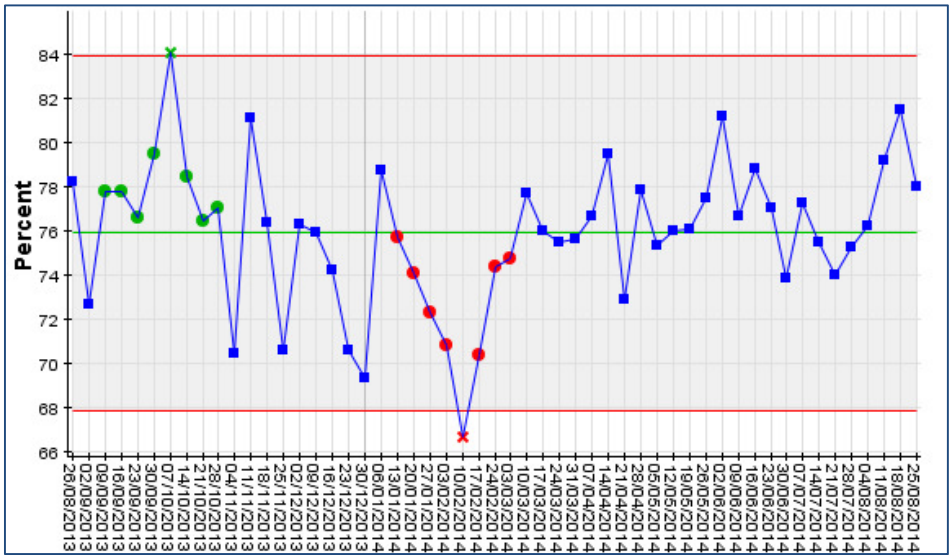
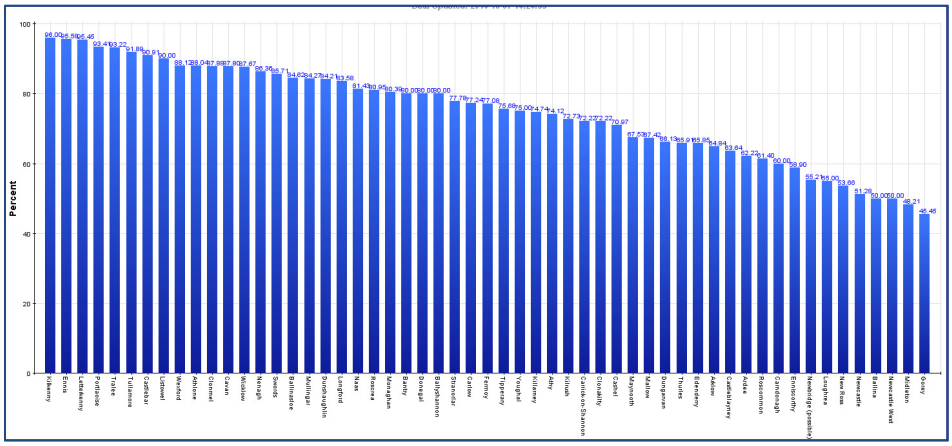


Figure 2-33 shows the 19 minute performance by drive zone for minor urban areas for the three months from June to August 2014, which ranges from 46% to 95%.

Figure 2-33: NAS minor urban Echo and Delta 19 minute performance by drive zone



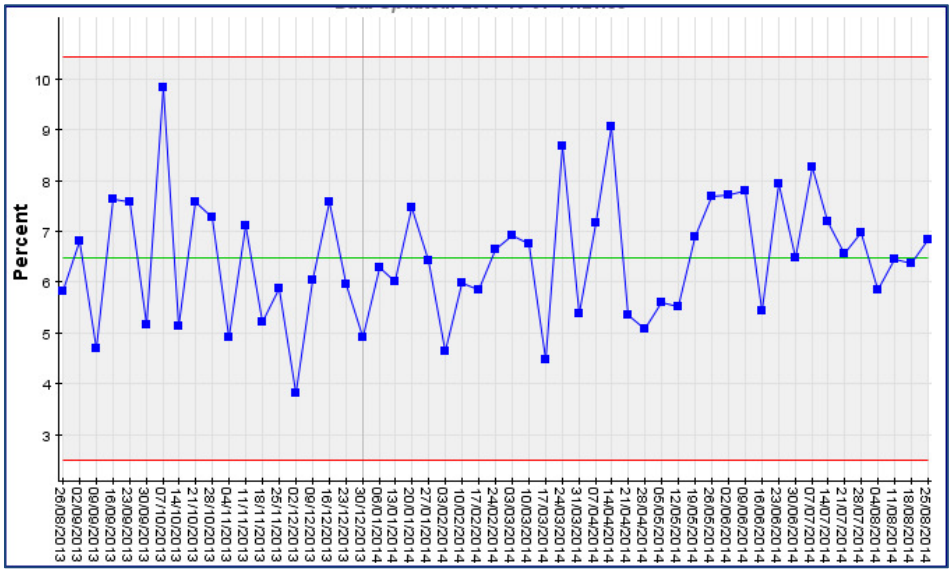
2.4.8 NAS Echo and Delta rural performance

Like all ambulance services, NAS faces a challenge in rural areas with low densities of calls. These areas have less than one call per week in a 5 kilometre radius which means it is not feasible to locate a dedicated ambulance resource to arrive in less than 8 minutes.

NAS 8 minute rural performance

Figure 2-34 shows that the 8 minute Echo and Delta performance for this area is averaging around 6%. 8 minute performance has been consistent over the last year.

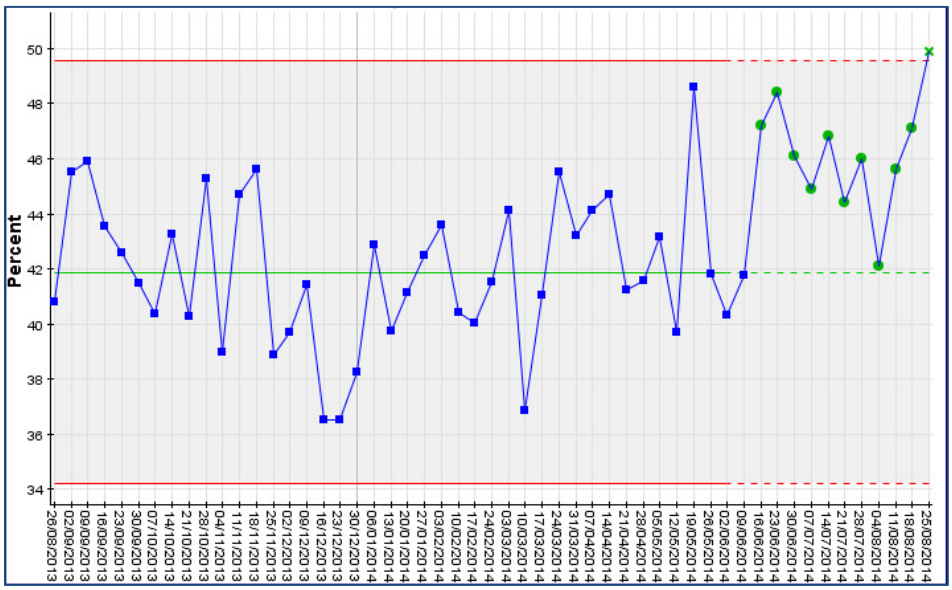
Figure 2-34: NAS Rural 8 minute Echo and Delta performance



NAS 19 minute rural performance

Figure 2-35 shows the 19 minute Echo and Delta performance for rural areas. The average performance has been around 42%. It has been trending upwards over the last year because of the introduction of extra ICVs.

Figure 2-35: NAS rural 19 minute Echo and Delta performance



2.4.9 NAS County Dublin performance (excluding DFB)

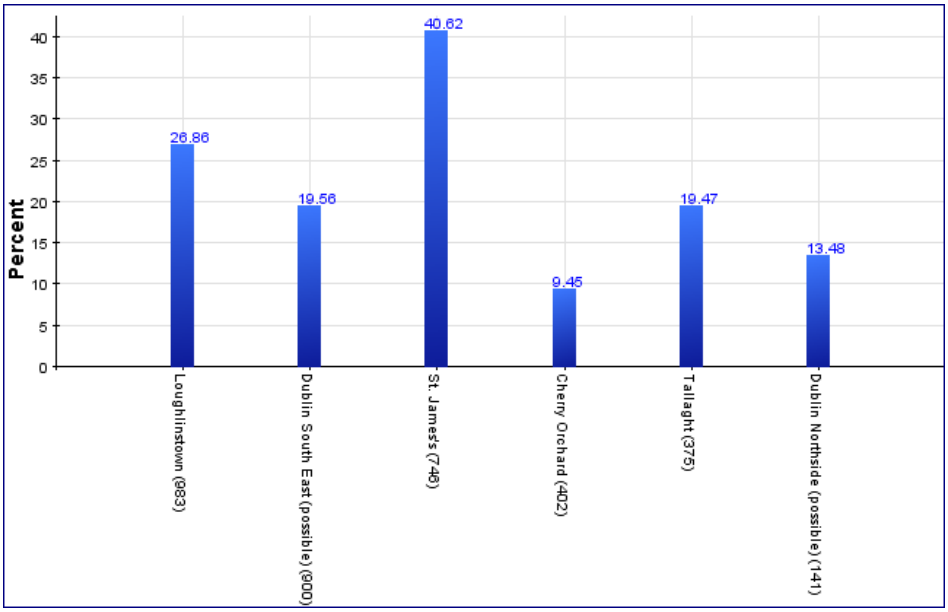
Emergency ambulance response in Dublin is provided by two services – NAS and DFB. DFB runs a fleet of 12 ambulances across the city, and responds to emergency incidents only. DFB can supplement emergency response by using fire service vehicles as needed, and can request support from NAS. Currently, NAS responds to all other urgent and routine demand across the city. NAS also handles emergency calls in some of the suburbs. As per our terms of reference, this report only looks at DFB activity, not at its performance.

The wider Dublin areas covered by NAS are categorised as major urban and they are the busiest areas that NAS responds to. Below we review some of the busier zones of Dublin, to investigate how they can be responded to more efficiently.

Figure 2-36 shows NAS 8 minute performance, for Echo and Delta calls, for Dublin broken down by area. This does not include any work done directly by DFB. This chart demonstrates the busiest area for NAS is Loughlinstown, which has an 8 minute performance of 27%. There are two areas (Dublin South East and Dublin Northside) where NAS responds to emergency incidents but does not have an ambulance station in the area, as they are covered primarily by DFB. Dublin South East has the second

highest demand and performs at 19%. St James is ranked third in the volume of demand and performs at 40%.

Figure 2-36: NAS Dublin 8 minute Echo and Delta by area



We review the St James and Loughlinstown areas in more detail in Section 2.5.5

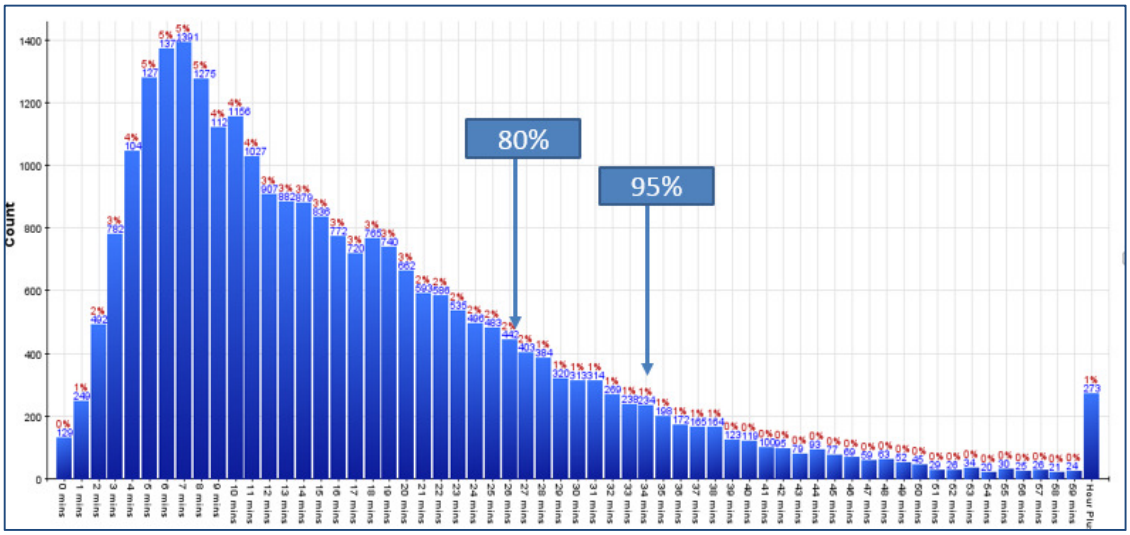
2.4.10 NAS performance tails

8 minute Echo and Delta performance tail

Figure 2-37 shows the distribution of response times for the first responder to Echo and Delta incidents across NAS areas in the three months from June to August 2014. It shows that 80% of patients are reached within 23 minutes, 95% within 30 minutes and 99% within an hour. Given the rural nature of

the communities that NAS serves, to have a tail of only 1% of patients waiting over an hour for care is good performance and compares well with other services.

Figure 2-37: NAS distribution of 8 minute Echo and Delta response times



19 minute performance tail

Figure 2-38 shows the distribution of response times for transporting vehicles for Echo and Delta incidents. This chart demonstrates that 70% of incidents are being attended within the 19 minutes and 99% within an hour.

Figure 2-38: NAS distribution of 19 minute Echo and Delta response times

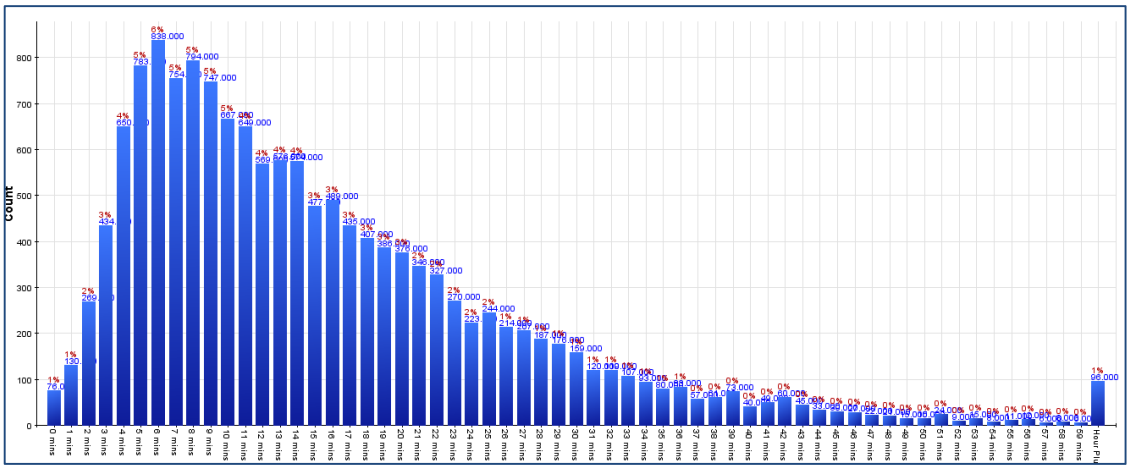


Figure 2-39 shows NAS 19 minute performance for Bravo and Charlie incidents. This chart demonstrates that 70% of incidents are being attended within the 19 minutes and 99% within the hour.

Figure 2-39: NAS distribution of Bravo and Charlie response times

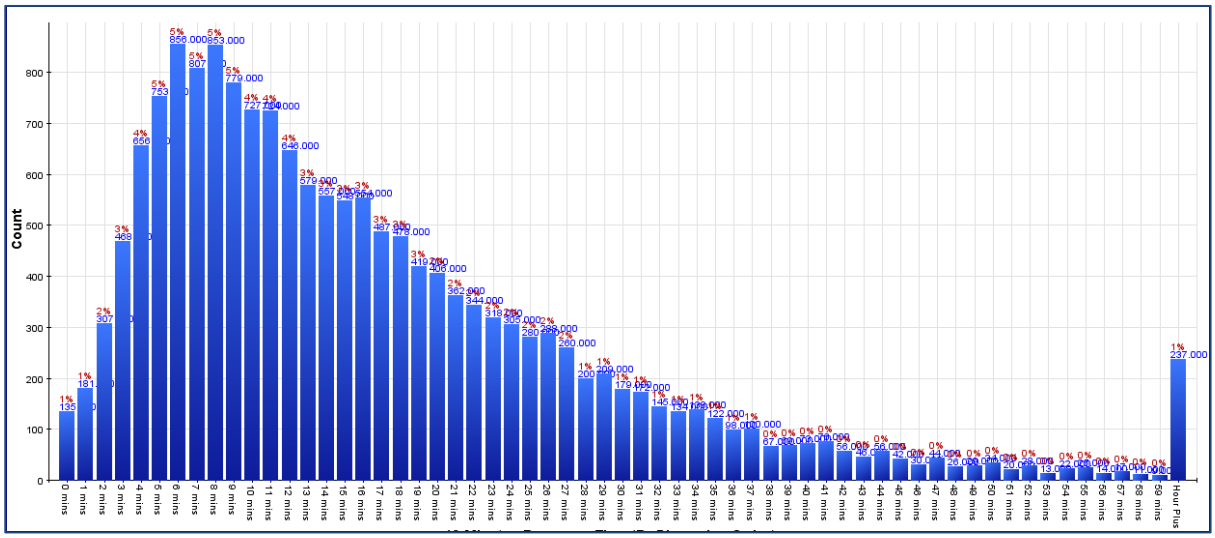
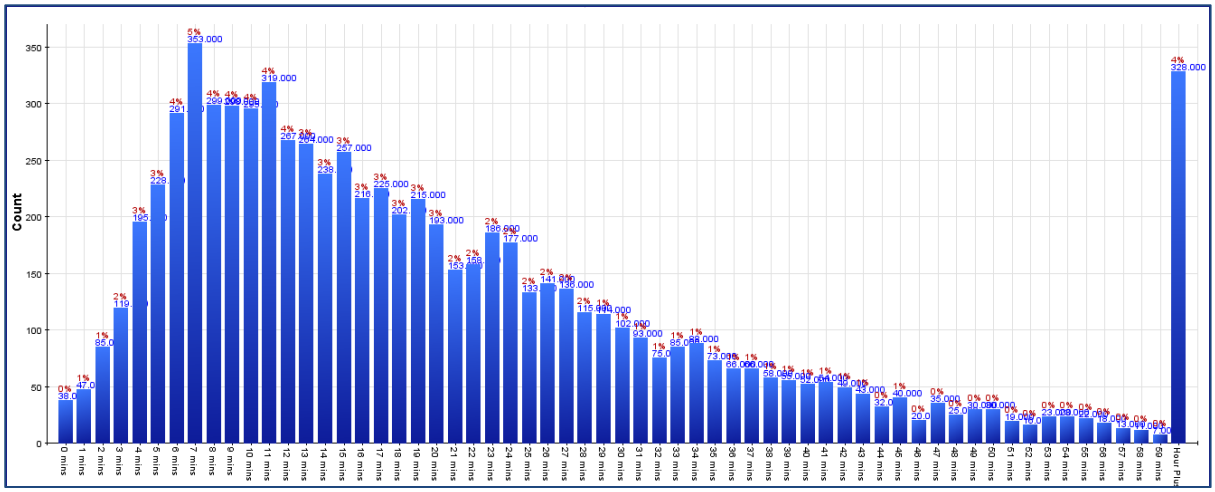


Figure 2-40 shows NAS 19 minute performance for Alpha and Omega incidents. This chart demonstrates that 80% performance is responded to within 33 minutes and 95% within an hour.

Figure 2-40: NAS distribution of Alpha and Omega response times



2.4.11 NAS performance summary

NAS has two response time performance targets – to be at scene 80% of the time in 8 minutes and 95% of the time in 19 minutes for Echo and Delta calls. These targets are stretching by international standards. Given the rural nature of the communities that NAS serves, it is not possible for NAS to achieve the 8 minute target: the best it could achieve, fully resourced and performing at best international standards, is 60.6%.

NAS is currently performing at 27% in 8 minutes and 67% in 19 minutes, which is below the standards observed in other services and suggests scope for improvement. Particularly in major urban areas, there is scope to improve performance. There is an encouraging improvement trend in 19 minute performance that is due to the introduction of additional ICVs which have reduced the workload on the emergency ambulances.

Our analysis of the performance "tail" for Echo and Delta calls shows that NAS are getting to 99% of their high acuity patients in less than one hour. Given the rural nature of the patch, this is a commendable performance and good by international standards.

We believe there is scope for NAS to improve overall operational performance by implementing a more systematic approach to day to day performance management and strategic planning. This would require investment in specialised technology to support improved understanding of operational data across all levels, from management to frontline staff.

In addition, we believe NAS would further benefit from adopting a structured approach to engaging staff in continuous performance improvement. This could take the form of a series of skill transfer initiatives, where staff can be trained in continuous performance improvement techniques.

Recommendation

NAS should invest in technology to support a more systematic approach to performance management and continuous improvement to enable full staff engagement.

2.5 Call cycle

The call cycle describes the processes that ambulance services follow in responding to calls. Analysis of the call cycle is very useful in identifying areas where performance can be improved.

The call cycle is made up of a number of steps. We will review each step in detail below, but initially consider the overall call cycle time.

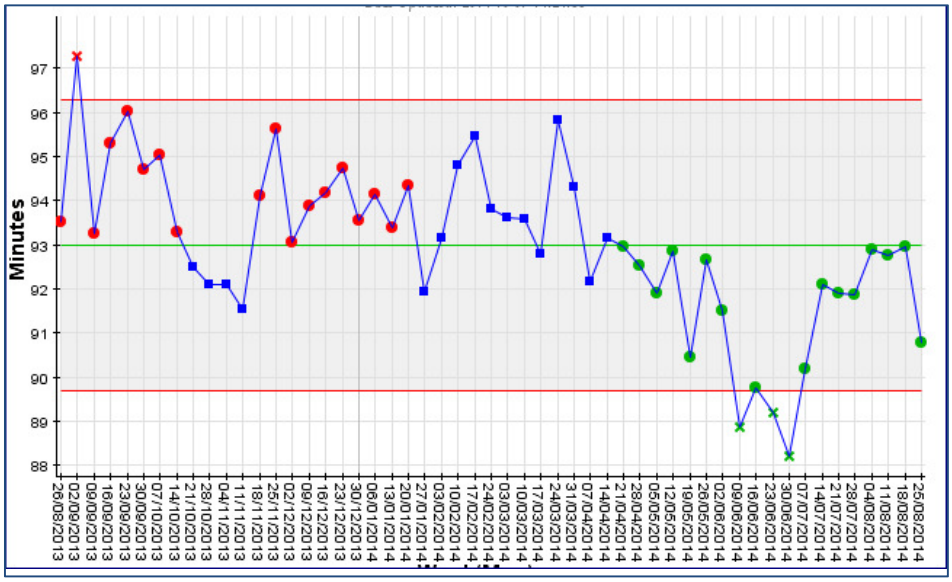
2.5.1 Call cycle time

The call cycle time is the time from the clock starting to the vehicle becoming clear. The vehicle can become clear on route, at scene or at hospital. The length of the cycle determines how quickly a resource becomes free to handle the next incident. NAS should aim for the optimum cycle time, taking into account that the rurality in Ireland will extend the journey times to hospital. Internationally call cycle time averages are often less than those seen in Ireland which is reflective of its high volumes of calls within the rural environment.

Cycle time by vehicle

Figure 2-41 shows the cycle time for patient-carrying vehicles that go to hospital. The chart shows that patient-carrying vehicles have a call cycle of 93 minutes. This is comparatively long by international standards, but is primarily explained by the extended travel time that NAS vehicles face both in attending incidents and in travelling from the incident to the destination hospital.

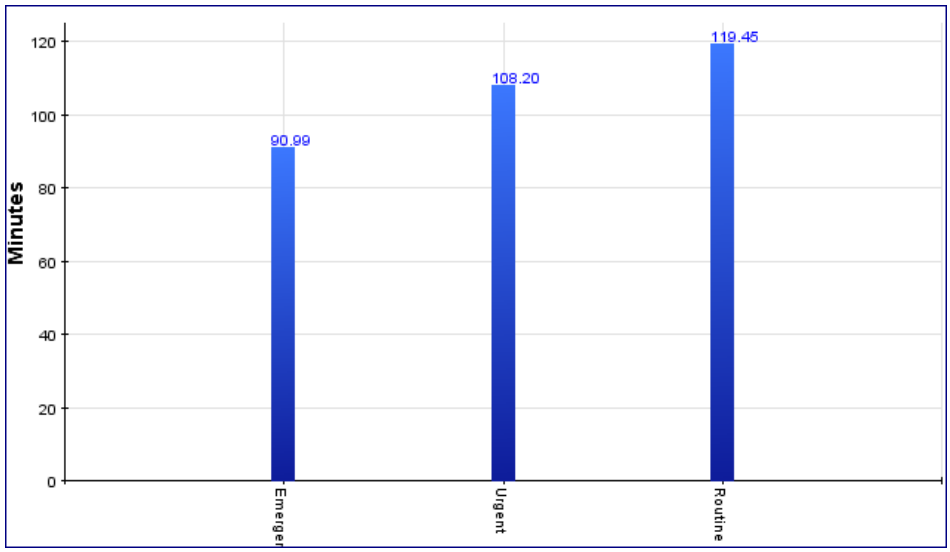
Figure 2-41: NAS cycle time by patient-carrying vehicles for emergency incidents that go to hospital



Cycle time by incident type

Figure 2-42 shows the NAS call cycle for all vehicles for the 3 incident types - emergency incidents take 91 minutes, urgent take 108 minutes and routine take 120 minutes.

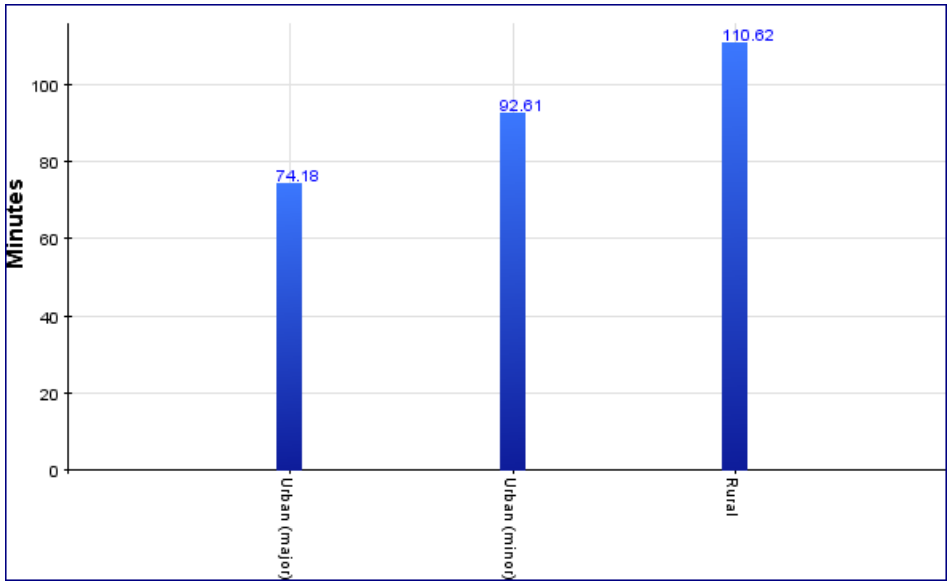
Figure 2-42: NAS call cycle for emergency, urgent and routine



Cycle time by geography – urban / rural

Figure 2-43 shows the NAS incident cycle time for emergency and urgent incidents by the 3 geographical regions. Major urban take 74 minutes, minor urban 93 minutes and rural 110 minutes. This variation is explained by the longer drive times in the smaller towns and rural areas.

Figure 2-43: NAS call cycle for major urban, minor urban and rural

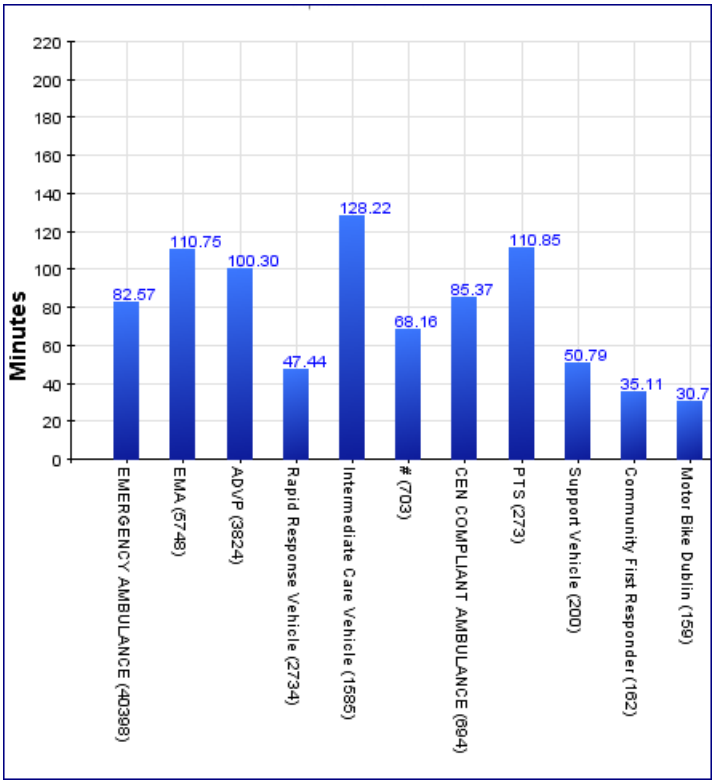


Cycle time by vehicle

Figure 2-44 shows the NAS cycle time by the different vehicle types. The chart shows that emergency ambulances have a call cycle of 96 minutes, ICVs 128 minutes and RRVs 48 minutes. However, it should

be noted that ICVs can carry multiple patients and so are a more efficient way of transporting less seriously ill patients.

Figure 2-44: NAS cycle time by vehicle type



Call cycle time summary

The cycle time for NAS vehicles is longer than the average cycle times seen in other services. This is largely caused by the rural nature of the geography. However, there is scope for improvement and this is considered in more detail in the next sections.

2.5.2 Clock start

In Ireland, clock start begins when the final determinant has been established (i.e. when NAS has identified the patient complaint). Reaching the final determinant can take up to 2 minutes from answering the call, but this is not recorded in this data set. The one exception is when calls arrive via DFB and the clock starts when the call is answered. It is therefore harder for NAS to achieve performance for these calls.

2.5.3 Allocation time

Allocation time is the time from clock start to allocating the call to the vehicle that subsequently arrives first at scene. It is partly dependent on resource availability and the requirement to allocate advanced paramedics (APs) to specific patient complaints. Figure 2-45 below shows that the average allocation time has been around 120 seconds. Since March 2014 the allocation time has dropped from 120

seconds to 100 seconds. This was achieved partly by introducing the ICVs (which reduced the demand on emergency ambulances) and partly by an increased focus on performance in the control room. Figure 2-46 shows allocation time by drive zone.

Figure 2-45: NAS allocation time for Echo and Delta

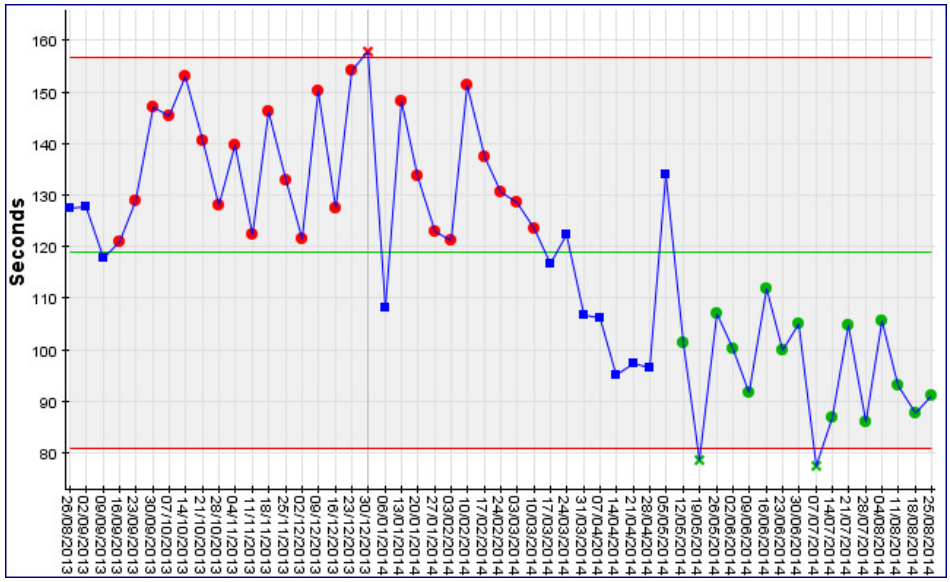
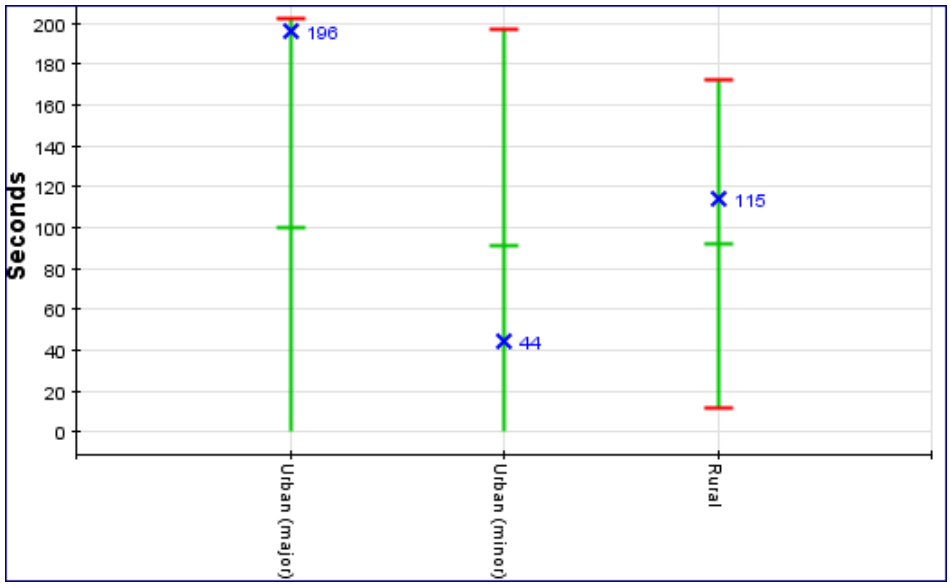


Figure 2-46: NAS allocation time for Echo and Delta by drive zones



International good practice for allocation time is around 45 seconds. We understand (and would support) that NAS is intending to introduce mobile data terminals (MDTs) in the near future. This will further help reduce the allocation times of vehicles. Even without this investment in new technology, we believe there is scope to reduce allocation times further by engaging and supporting staff and greater management focus.

Recommendation

NAS should review its vehicle allocation processes with the aim of reducing the time from call determinant (identification of patient complaint) to vehicle allocation from 100 seconds to 45 seconds (although full achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).

International good practice identifies Echo calls earlier in the control room process, enabling vehicles to be dispatched more quickly for patients with immediately life-threatening conditions. This is normally done by reviewing the order of the questions asked by the call taker, to identify certain key words to trigger the earlier response.

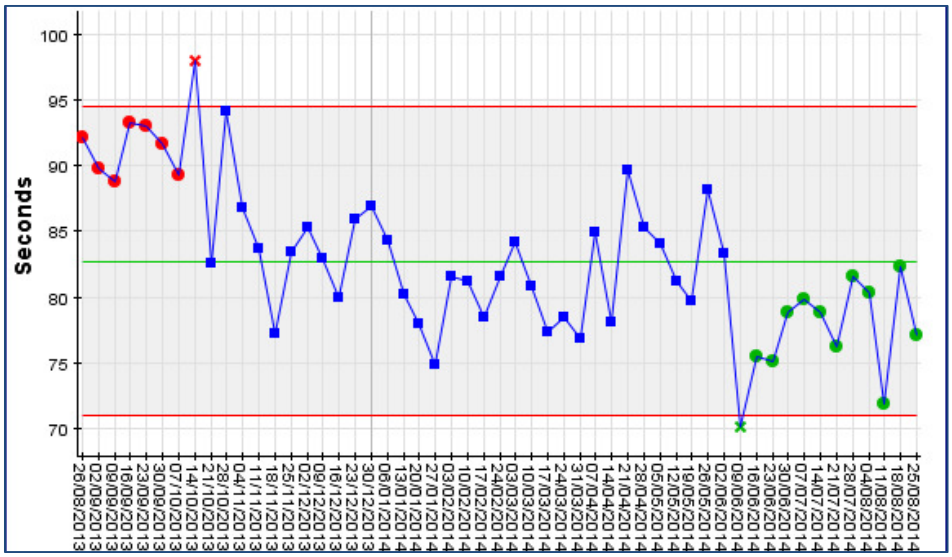
Recommendation

NAS should introduce a process for earlier identification of, and dispatch of a vehicle to, Echo (immediately life threatening) calls.

2.5.4 Mobilisation

Mobilisation time is the time it takes from a vehicle being allocated a job to the crew going mobile in their vehicle. Best international practice is around 45 seconds and NAS average is around 80 seconds. Mobilisation time is partly dependent on technology and partly dependent on behaviour. The introduction of MDTs will help improve performance. However, we believe that further improvements can be made through staff engagement and support and management focus.

Figure 2-47: NAS mobilisation time for Echo and Delta



Recommendation

NAS should review its vehicle mobilisation processes with the aim of reducing the time from allocation to vehicle mobile from 80 seconds to 45 seconds (although full

achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).

2.5.5 Travel time to scene

Travel time to scene is the time taken from the vehicle going mobile to it arriving at scene. It has decreased steadily since January 2014. The introduction of ICVs, has played a major part in this improvement by reducing the non-emergency work of emergency ambulances. Figure 2-48 shows that travel times have improved from an average of 16 minutes to around 15 minutes. However, a challenge clearly remains, given that the response time target is 8 minutes.

Figure 2-48: NAS travel to scene time for Echo and Delta incidents

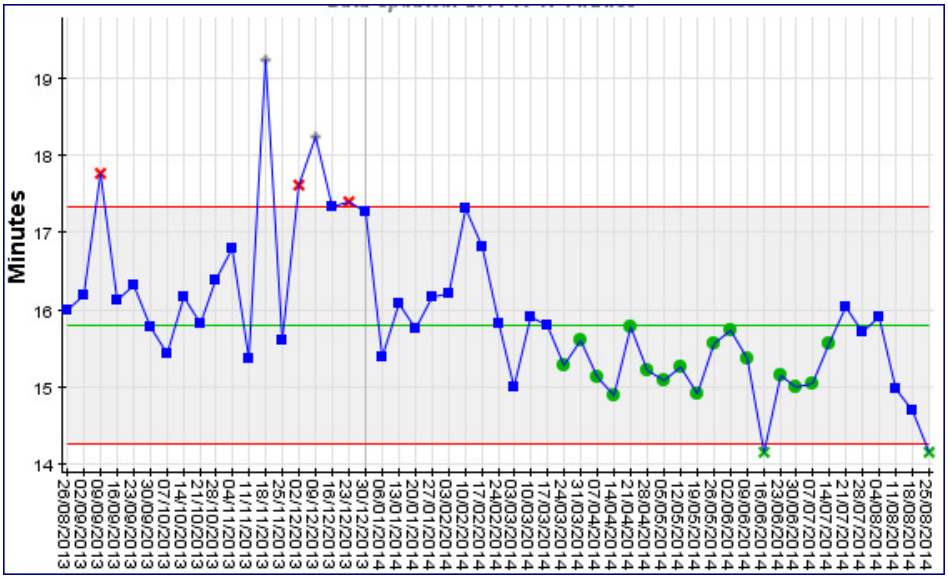
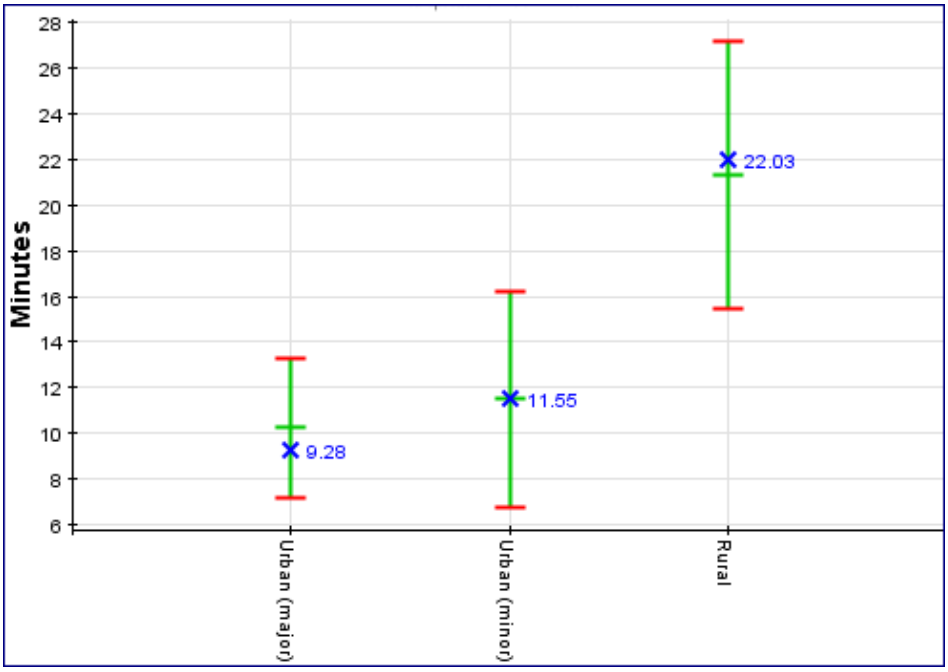


Figure 2-49 shows NAS variation in travel to scene time by the 3 areas. As one would expect the drive times in rural areas are longer than the urban equivalent for Echo and Delta incidents. The major urban drive time has an average of 10.7 minutes, minor urban 12 minutes and rural 22 minutes.

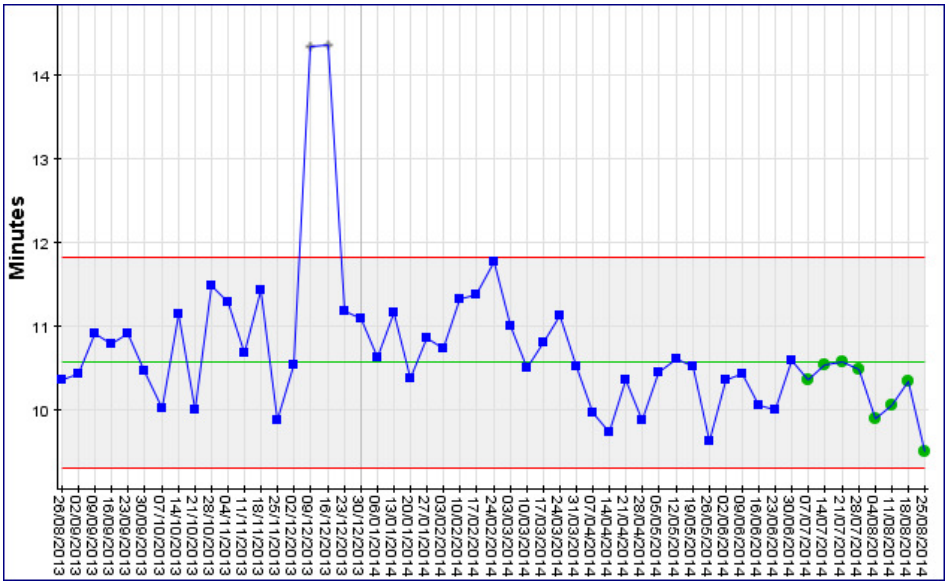
Figure 2-49: NAS travel to scene time for Echo and Delta incidents by area



Travel time to scene for NAS major urban incidents

Figure 2-50 shows that travel to scene time for Echo and Delta calls, in major urban areas averages 10.7 minutes. International best practice is an average drive time of between 4 and 5 minutes in urban areas.

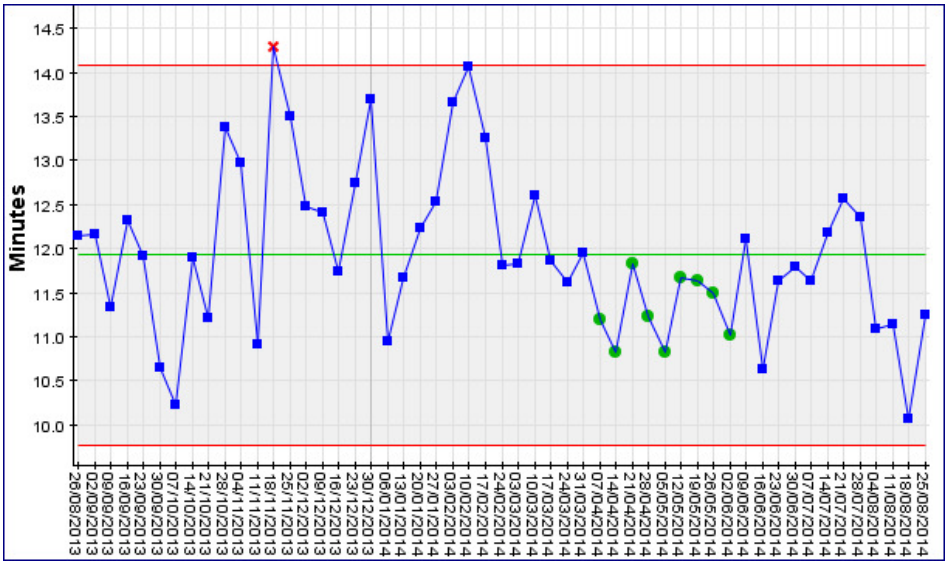
Figure 2-50: NAS major urban travel time to scene



Travel time to scene for NAS minor urban incidents

Figure 2-51 shows the travel to scene time, for Echo and Delta calls, in minor urban areas. There was a significant improvement in both the drive time average and the drive time consistency in March 2014 following the introduction of the extra ICVs. However the average of over 12 minutes is high compared to international good practice of around 6 minutes.

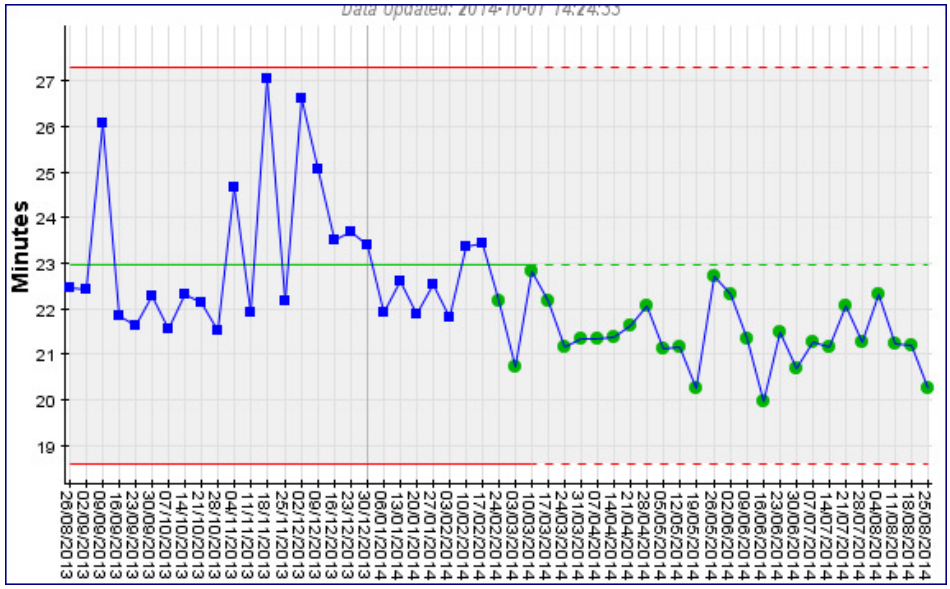
Figure 2-51: NAS minor urban Echo and Delta travel time to scene



Travel time to scene for NAS rural incidents

Figure 2-52 shows the travel to scene time, for Echo and Delta incidents in the rural area. The 2013 average is around 23 minutes with performance having improved since the start of the year.

Figure 2-52: NAS rural travel time to scene for Echo and Delta



Travel time to scene for NAS Dublin incidents

Figure 2-53 shows the travel time to scene time for Dublin's Echo and Delta allocations. The average time is around 11 minutes, compared to good international practice of 4 minutes. The chart also shows a particular spike in drive times at the year-end which suggests that, at this time, vehicles were travelling from outside Dublin to respond to incidents in the city

Figure 2-53: NAS Dublin Echo and Delta travel time to scene

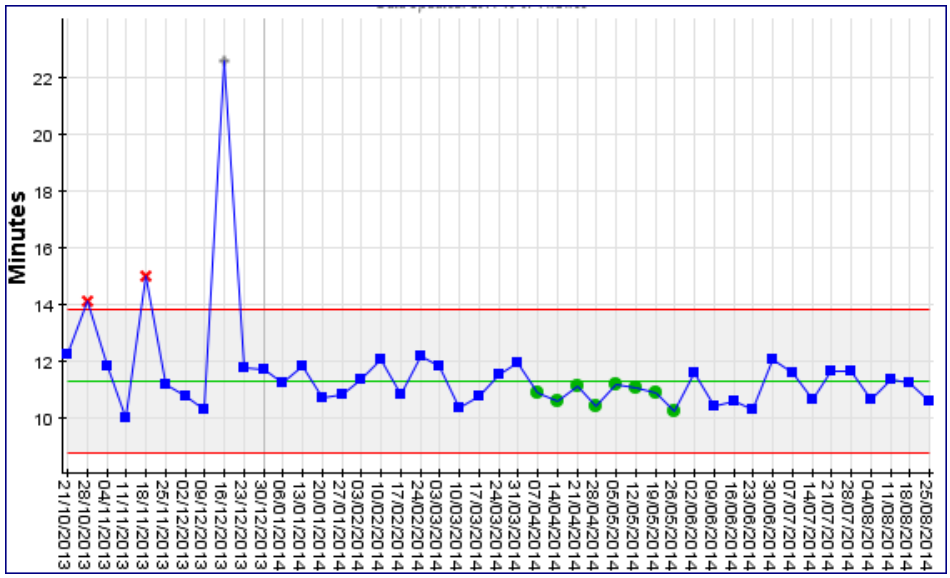
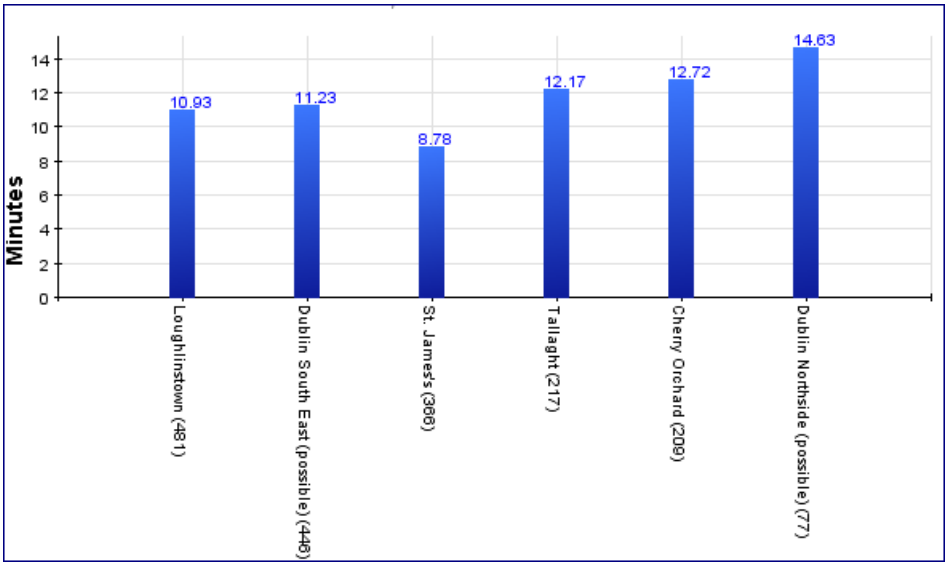


Figure 2-54 shows the travel time to scene in Dublin broken down by area. It shows that the average for all of the six urban areas in Dublin exceeded the 4 minute travel time target. In some areas where NAS does not have a station, it reaches an average of nearly 14 minutes. This strongly suggests that vehicles are not being deployed from the best start points and improvements in performance can be achieved by reviewing initial deployment points.

Figure 2-54: NAS Dublin Echo and Delta travel time to scene by area



We will now consider in more detail two of the areas – St James and Loughlinstown.

Travel time to scene for NAS St James, Dublin

Figure 2-55 reviews the St James, Dublin, travel time to scene from the vehicle's assigned location. The drive to scene time for the majority of locations exceeds the required target. This analysis suggests

that vehicles within the St James area are deploying from an inappropriate location and that in many cases vehicles are being deployed from outside the area to incidents in the St James area.

Figure 2-55: NAS Dublin St James station Echo and Delta travel time

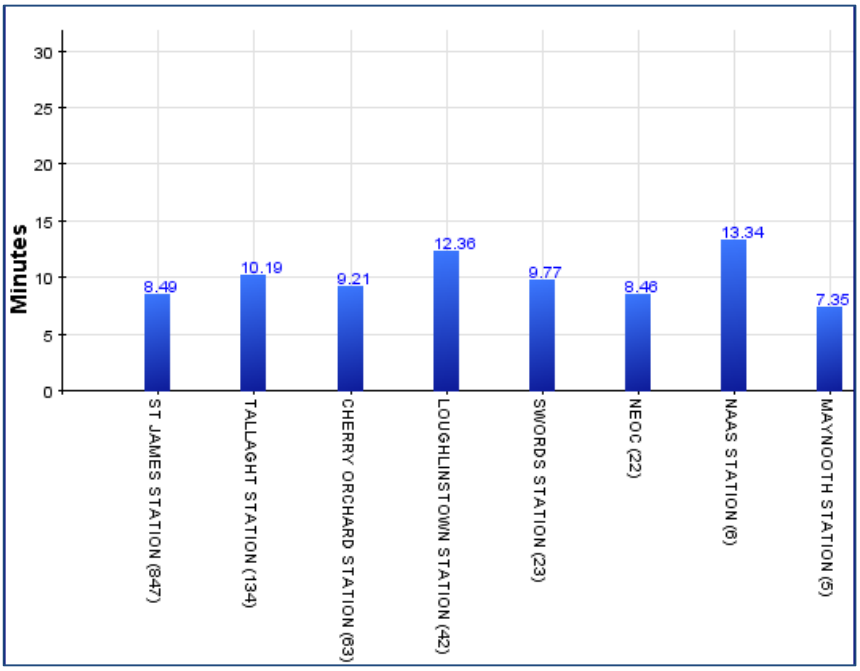
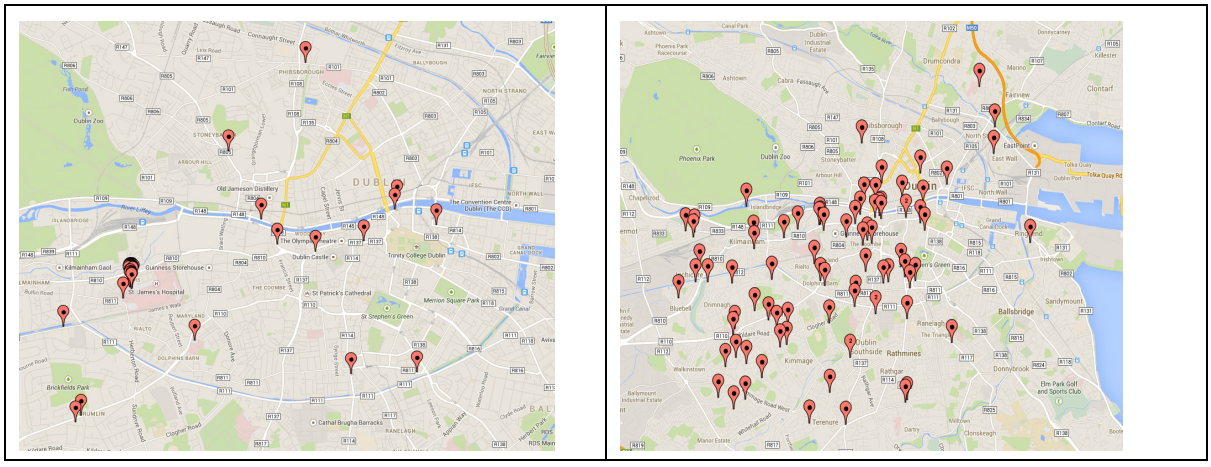


Figure 2-56 below shows where vehicles were (left-hand map) when they were allocated to incidents in the St James area (right-hand map). The majority of the incidents were allocated to vehicles based at St James station, and on average drive time was 8 minutes. This shows that the St James station is not the right place for a deployment point serving the area.

Figure 2-56: NAS St James, Dublin Echo and Delta allocation location (left) and where the incident was (right)



Travel time to scene for NAS Loughlinstown, Dublin

Loughlinstown is the busiest area for NAS in Dublin, accounting for just under a fifth of its Dublin work. Figure 2-57 shows NAS 8 minute Echo and Delta performance in this area is around 32% even when

the responding vehicle is located in the Loughlinstown area. This indicates that Loughlinstown is an area that should be a focus for service improvement.

Figure 2-57: NAS Dublin Loughlinstown Echo and Delta 8 minute performance for incidents responded to by vehicles located in the Loughlinstown area

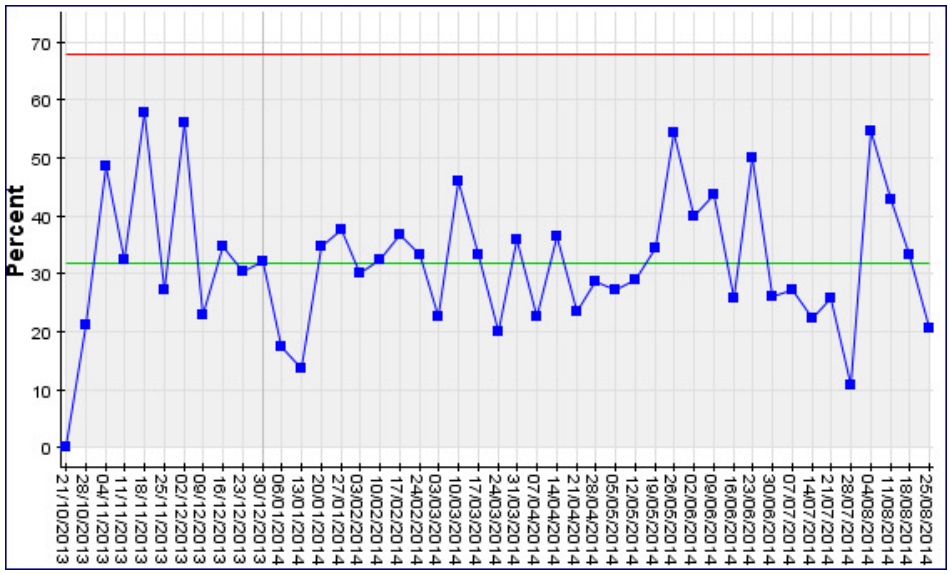
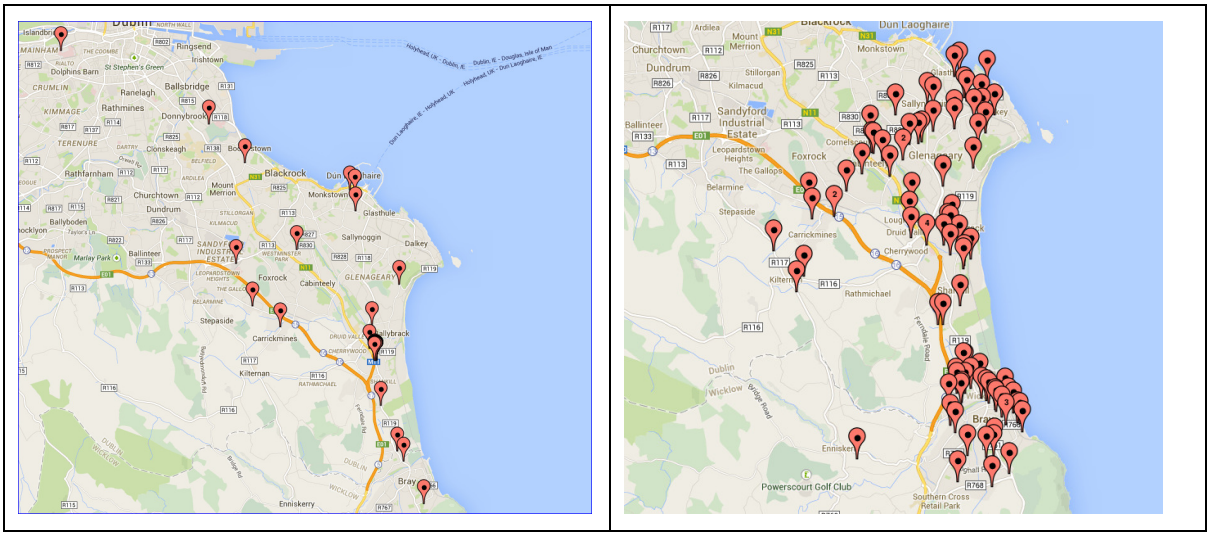


Figure 2-58 below shows where vehicles were (left-hand map) when they were allocated to incidents in the Loughlinstown area (right-hand map). The majority of the incidents were allocated to vehicles based at Loughlinstown station, and on average drive time was 9.8 minutes. This shows that the Loughlinstown station is not the right place for a deployment point serving the area.

Figure 2-58: NAS Loughlinstown, Dublin Echo and Delta allocation location (left) and where the incident was (right)



The above analysis shows that drive times in the urban areas are far too long to enable response time targets to be met. The analysis further shows that the root cause of this problem in many cases is the location of the deployment points. These are frequently at ambulance stations which are too far from

the centres of demand. A thorough review is needed of deployment points in both major urban and minor urban areas.

Recommendation

NAS should undertake a review of all vehicle deployment points in both major and minor urban areas to reduce drive times, aiming for an average drive time of 4 minutes in major urban areas. (See Appendix E for proposed major urban deployment points).

2.5.6 Time at scene

Figure 2-59 shows that time at scene for emergency and urgent incidents has decreased slightly over the last year, to an average of 21 minutes. 20 minutes is international best practice for similar ambulance services.

Figure 2-59: NAS time at scene for incidents that are taken to hospital

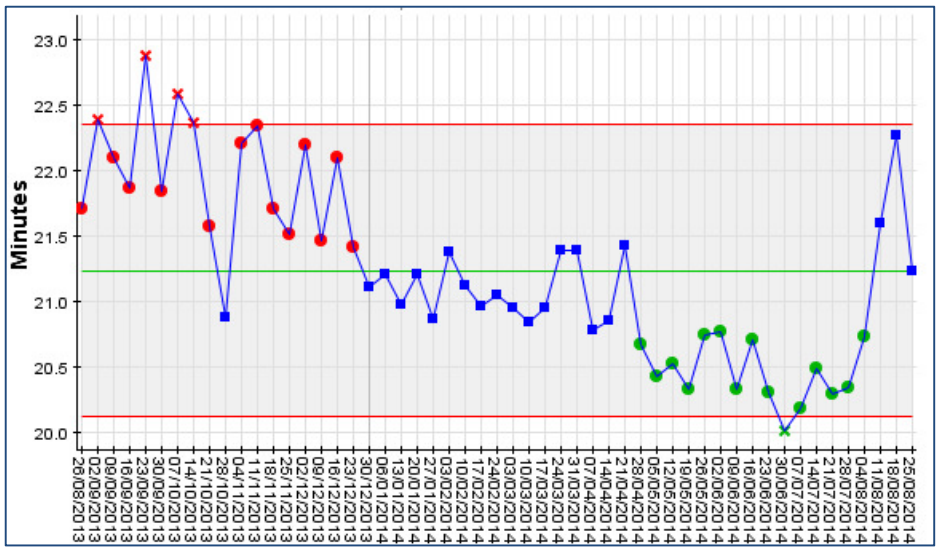
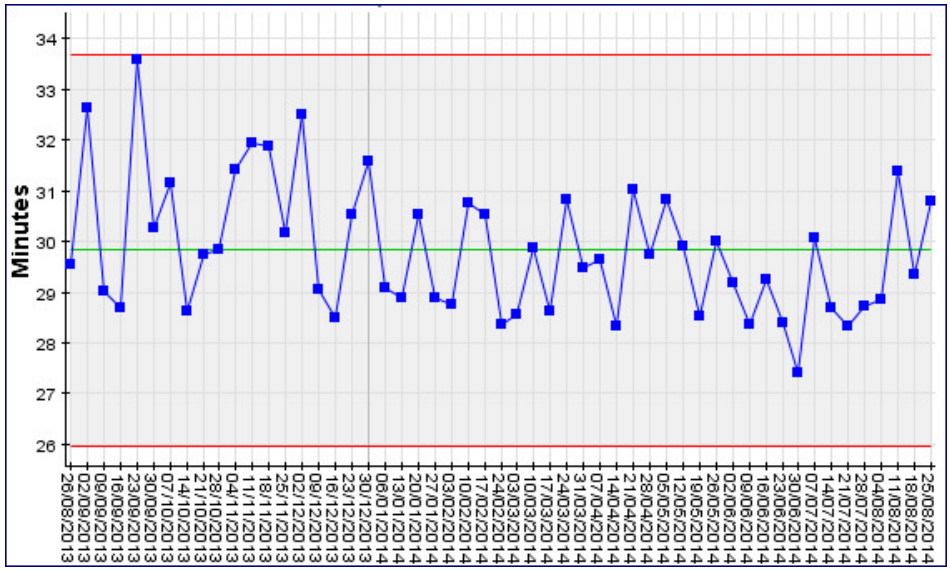


Figure 2-60 shows NAS time at scene for incidents where a crew clears at scene, which has remained relatively stable over the last year, with an average of 30 minutes, which matches international good practice.

Figure 2-60: NAS time at scene for incidents where the crew clears at scene



2.5.7 Travel time from scene to hospital

Figure 2-61 shows NAS travel time from scene to hospital has remained relatively stable over the last year, at an average of around 26 minutes.

Figure 2-61: Travel time from scene to hospital

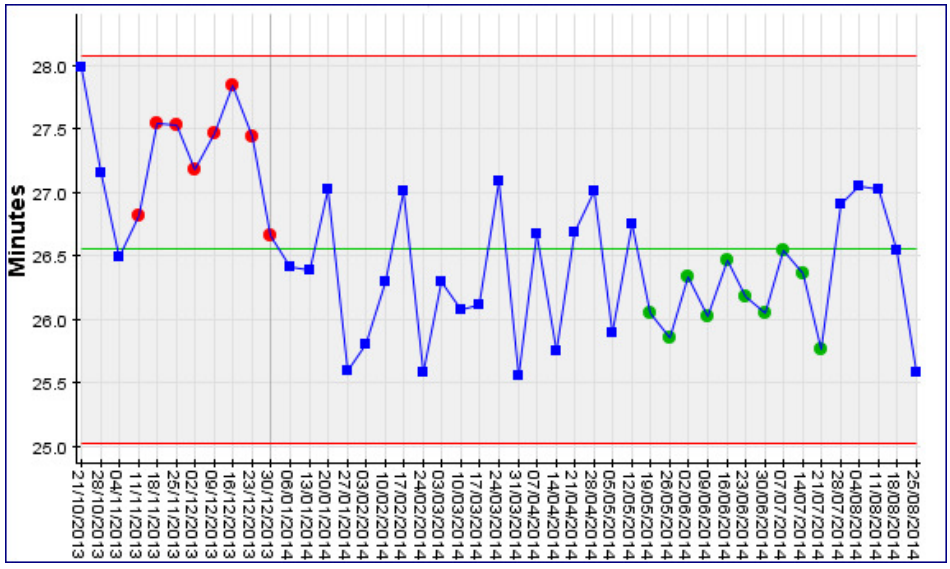
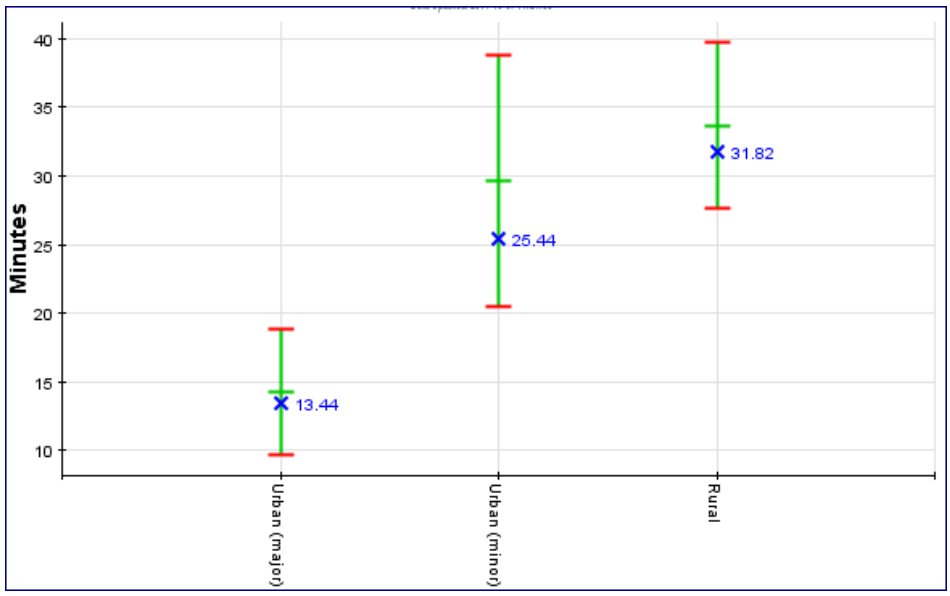


Figure 2-62 shows NAS travel time from scene to hospital by drive zones. Major urban average time to hospital is 14 minutes, minor urban 29 minutes and rural 34 minutes.

Figure 2-62: Travel time to hospital by drive zones



2.5.8 Time at hospital to clear

Time at hospital to clear is the time from when an ambulance arrives until it is available for the next deployment. Figure 2-63 shows emergency ambulance time at hospital until becoming clear, which has remained at an average of 32 minutes. International best practise is less than 30 minutes with 15 minutes for hand over and 15 minutes for wrap up. Therefore, on average NAS is performing to a good standard.

Figure 2-63: Average time at hospital

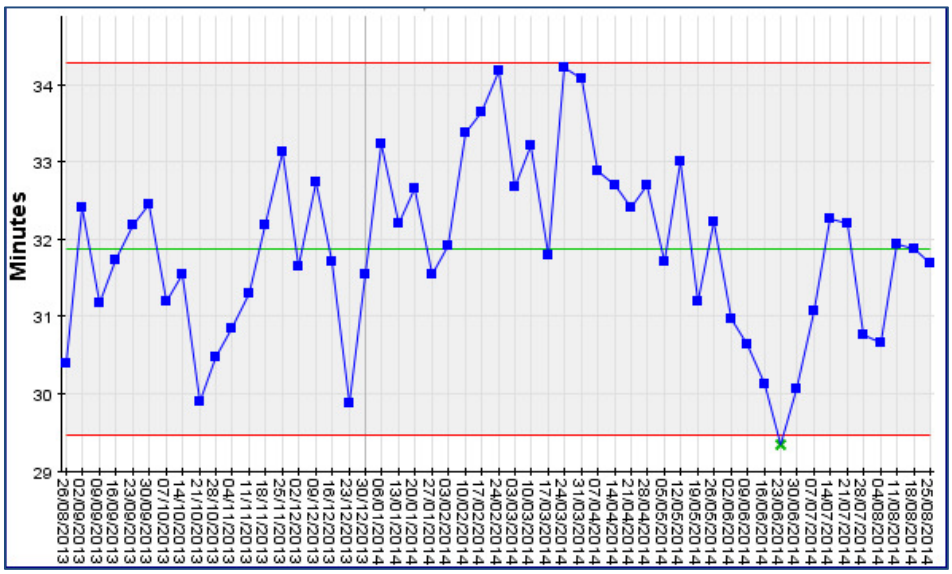
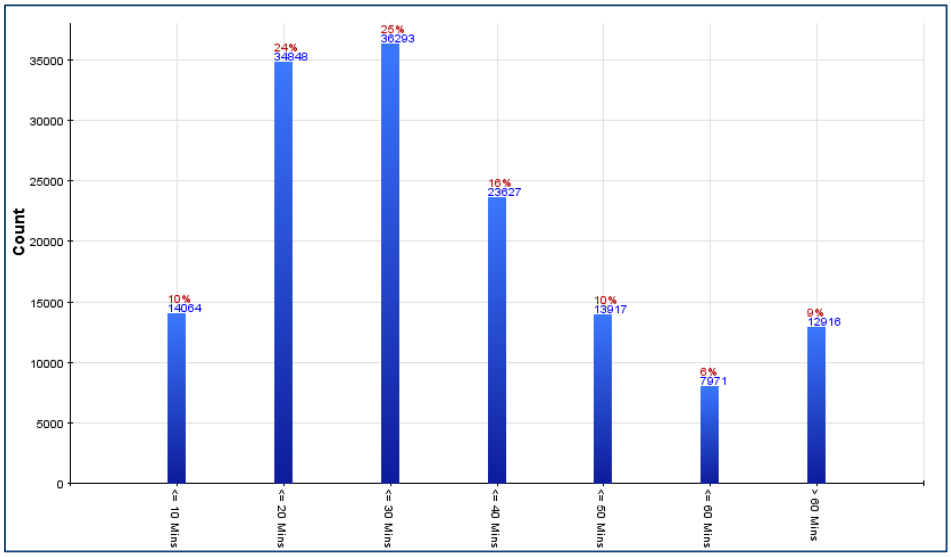
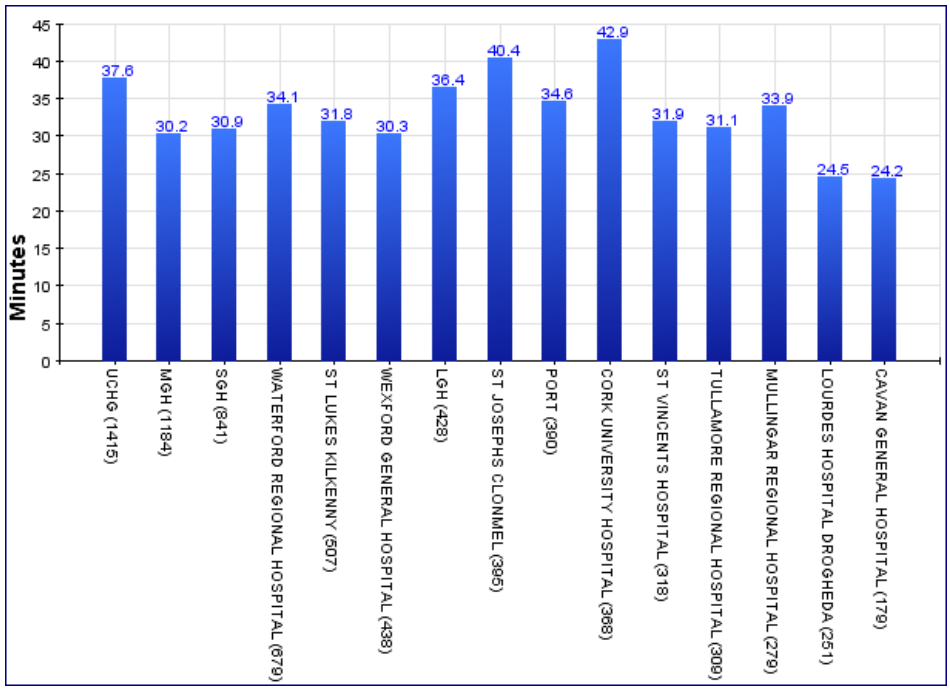


Figure 2-64: Total time at hospital



However, as Figure 2-65 shows, there is considerable variability in the time at hospital across the different hospitals to which NAS transports patients. There is, therefore, clearly an opportunity to improve performance at some hospitals.

Figure 2-65: Time at hospital by selected destination hospitals



Recommendation

NAS should work in partnership with identified hospitals to reduce the time spent by ambulances at hospital and ensure safe handover of patients.

2.5.9 Call cycle summary

NAS call cycle time is relatively long by international good practice standards. This is partly a function of geography and call distribution but there are improvements that NAS can make to shorten the cycle, reduce response times and increase availability.

In particular, we recommend focusing on improving allocation and mobilisation times and on reviewing deployment points in major urban and minor urban areas to reduce drive times. The impact of these recommendations is considered in greater detail in the next section.

3 Demand

3.1 Historical trends in demand

Graphs showing historical trends in demand in emergency, urgent and routine activity are shown in Section 2.3.2. These show the following:

- Emergency activity – this shows a consistent underlying growth of 6.5% over the last three years. This is broadly in line with international experience and can be expected to continue
- Urgent activity – declined by around 10% per year between 2011 and 2013 but has now stabilised over the last year. Based on these trends, our assumption is that that this relative stability will continue
- Routine activity – has been heavily influenced by the ability of NAS to handle the work. When NAS capacity was constrained, hospitals reacted by moving routine activity to private providers. When NAS expanded capacity in November 2013, the hospitals returned the work to NAS and activity picked up again. Since around March 14, activity has again stabilised. Based on these trends, our assumption is that this relative stability will continue unless NAS expands the ICV fleet

3.2 Projected activity growth

Table 3-1 below shows projected future demand based on the assumptions

Table 3-1: Projected activity growth per year 2013-14 to 2015-16

	% of total activity	Projected growth %	Contribution to growth
Emergency activity	68%	6.5%	4.4%
Urgent activity	15%	0.0%	0%
Routine activity	17%	0.0%	0%
Total activity			4.4% (rounded to 4%)

There are a number of risks associated with these assumptions including:

- Population growth and net migration
- Emergency demand per capita rising to UK levels
- Hospital reconfiguration
- Changes in Health charging policies (Universal Health Insurance)

These are considered in more detail in Section 9.

Table 3-2 shows the estimated extra resources in year one required to handle the growth projected in Table 3-1 of 6.5% emergency activity.

Table 3-2 shows the number of additional hours required by vehicle type in year one. There is a degree of spare utilisation that is available to absorb the initial growth. The table also shows the additional staff required in year one to handle the expected growth, broken down by roles: Advanced Practitioner (AP) / Paramedic; and Emergency Medical Technician (EMT).

Table 3-2: Resources required to handle projected activity growth to 2015-16

	Ambulance	ICV	RRV	Total
Additional roster hours for increase in emergency activity in Year 1 @6.5%	612	0	0	612
		AP / Paramedic	**EMT**	**Total**
Additional emergency staff required in Year 1		22	0	22

Table 3-3 shows the estimated extra resource for years 2016 – 19, based on the growth projection of Table 3-1 of 6.5% emergency activity. It shows the resources required in the fourth year. This demonstrates there is less spare capacity to absorb the additional activity in these years 2016 -19. It also shows the additional staff by skill type that would be required to support this activity. We have also shown a second growth assumption in years 2 – 4, of 8% due to the above sensitivity analysis.

Table 3-3: Resources required to handle projected activity growth to 2016-19

	Ambulance	ICV	RRV	Total
Additional roster hours for increase in emergency activity in Years 2-4 @6.5%	3196	0	168	**3364**
Additional roster hours for increase in emergency activity in Years 2-4 @8%	4019	0	252	**4271**
		AP / Paramedic	**EMT**	
Additional emergency staff required Years 2-4 @6.5%		**121**	**0**	**121**
Additional emergency staff required Years 2-4 @8%		**152**	**0**	**152**

4 Capacity modelling

This section outlines the model used to determine system capacity and the potential performance levels that NAS should be able to achieve with different levels of resourcing. It reviews how the model has been implemented (including any assumptions), presents and discusses the findings, and makes recommendations.

4.1 The impact of geography and call frequency

There are a number of factors to consider when determining the achievability of the performance targets, such as geography, demography, transport, road and health infrastructures and the amount of resource that is available.

A key factor when planning deployment points and response models to meet the 8 minute and 19 minute response time targets is the call frequency by geographic area. To support this we use the following criteria in modelling resource needs by area:

- Major urban areas receive 6 or more emergency or urgent incidents per 24 hour period within a deployment area bounded by a 6-minute drive time (based at normal travel speeds) which equates to an area with a 5 kilometre radius
- Minor urban areas receive 1-6 emergency or urgent incidents per 24 hour period within a 6-minute drive time
- Rural areas receive fewer than 1 emergency incident per 24 hour period within any 6-minute drive time

4.2 Echo and Delta response areas and achievable standards

In order to meet an 8 minute standard, an ambulance service has to plan with a high level of certainty to have a suitable level of response resource available that is capable of attending these life threatening and potentially life threatening incidents within the time allowed for the response. The amount of resource that is required to deliver this standard of response is determined by the likely location of the incident, the amount of time that the control room has to process the call, and the time the responder has available to travel to the incident.

The time that is available for the responder to travel to the scene of the incident is the time that remains within the 8 minute response window once:

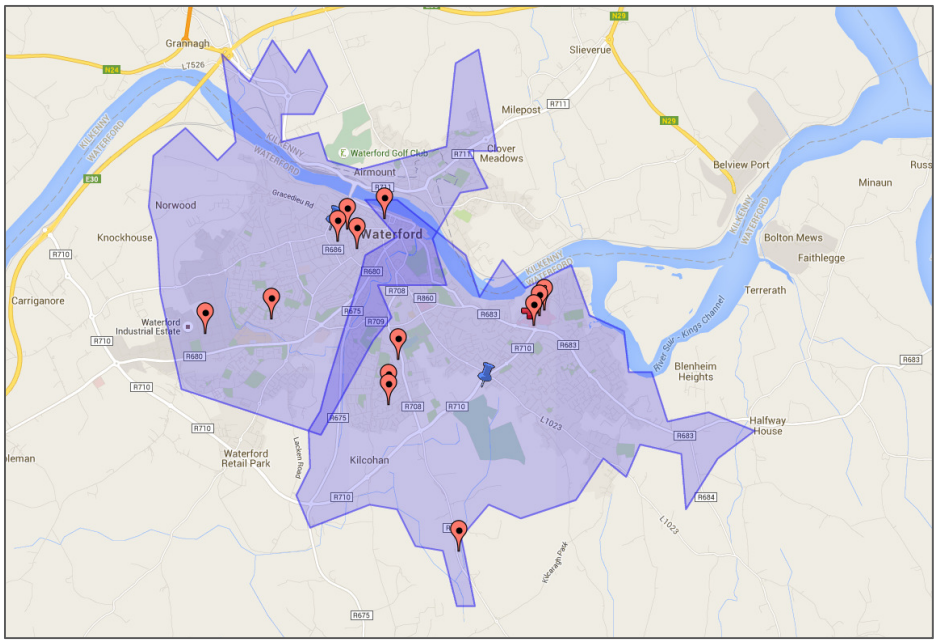
- The responder has been identified and allocated
- The responder has been notified of the incident
- The responder is in the response vehicle and mobile to the scene of the incident

The implication of this is that it is only possible to reach an Echo or Delta incident within the 8 minute window where there is a response resource that is already available and positioned within a 6 minute drive time of the incident at the time that the clock starts. Consequently, in determining the amount of resource that is required to meet the Echo and Delta 8 minute standard it is necessary to identify

the locations where incidents are most likely to occur and to plan the deployment of the NAS response resource within those areas.

A typical area that could be covered within a 6 minute drive time is shown in Figure 4-1.

Figure 4-1: Area of Waterford covered by two 6-minute drive time zones



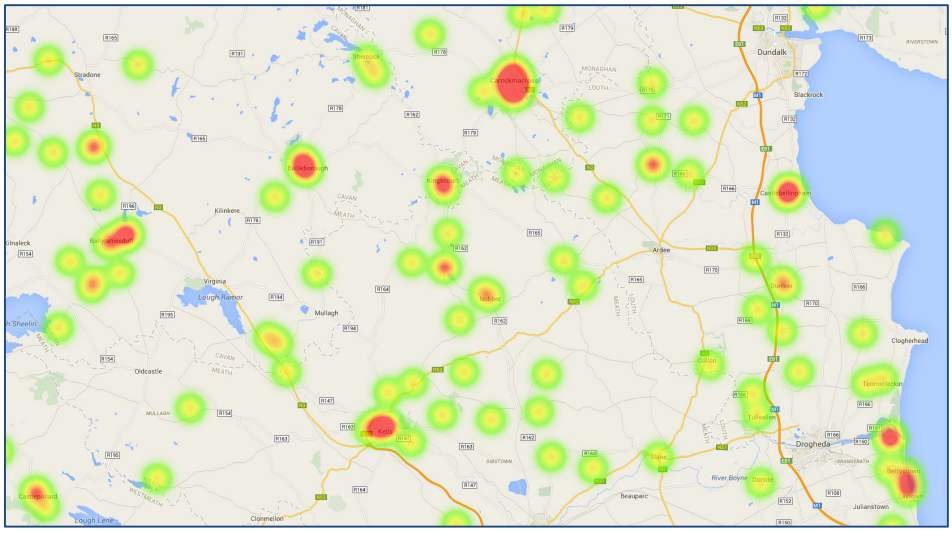
Having identified those areas where Echo and Delta incidents are most likely to occur, it is then possible to identify the optimal location of response vehicles within 6 minute deployment areas to maximise the likelihood that the incident will receive a response within the 8 minute response window. Where adequate resource is available and is deployed in this way, a high level of Echo and Delta performance can be achieved.

As outlined in Section 2.2.3 above, the geographical area covered by NAS has a relatively small proportion of activity that occurs in major urban areas (by comparison with other ambulance services). It also has a much larger proportion of activity that occurs in a large number of smaller urban centres, where typically there is only one ambulance available to provide a response and the time taken to transport a patient to the nearest hospital can often be in excess of an hour. This creates a challenge for NAS to achieve a consistent level of performance in these areas, as once the local ambulance is committed to an incident it is not available to respond to a second incident should this occur before it has returned from transporting the patient on a preceding incident.

In the smaller towns and larger villages where there is no ambulance located, it is significantly more difficult for ambulance services to provide an assurance of a suitable level of initial response without the involvement of volunteer responders. As Figure 4-2 illustrates, in the area covered by NAS there are many communities of this type, that are more than a 6 minute drive from the nearest town and where, typically, there will be at most one or two Echo and Delta incidents per week. The only practical way of providing an initial response in these areas within the 8 minute window is through a voluntary

Community First Responder (CFR) scheme. Where such schemes exist, they can provide a high level of initial response to their local community, but the development of schemes of this type is time consuming and requires a high level of commitment from both the local community and ambulance services. It should be recognised that although the CFRs are volunteers, the infrastructure necessary to support, manage and deploy them has its own cost that has to be borne by ambulance services.

Figure 4-2: Representative heat map of incidents in locations where NAS has no ambulance station



In the more remotely populated areas, which are outside the reach of a community response scheme, it is unrealistic for any ambulance service to plan to achieve any sustained level of 8 minute performance. From our experience, ambulance services find it very difficult to achieve levels of 8 minute performance outside those locations where they either have an ambulance station or an established CFR scheme. It is therefore important in these areas that a focus is placed on achieving an acceptable response to high acuity incidents by a transporting vehicle within a reasonable timeframe. In order to achieve this it is important that NAS can maintain a model of geographical coverage that ensures that an available transport resource is available not only to the normal daily levels of activity, but also to peak levels of activity in order to be able to respond to an Echo or Delta call within the specified target timeframe across all the geographic regions that it covers.

The model considers certain factors that determine the amount of ambulance resource that is required to meet Echo and Delta standard, as follows:

- The predicted average and peak level of activity at each hour, for each day of the week
- The volume of activity and the geographic area that can be covered by an ambulance operating in more rural areas
- The percentage of incidents that require transportation to hospital
- The length of time that it takes an ambulance to complete an incident, including:
  - Time taken at the scene of the incident
  - Time taken to reach the hospital

- Time taken to hand over the patients to the care of the hospital staff
- Time taken to return from hospital to the home ambulance station

In calculating this resource requirement, it is important to recognise that the same resource is also required to meet the performance standards for other categories of emergency and urgent activity, as well as undertaking a proportion of the routine workload that cannot be covered by ICVs.

4.3 Deployment areas

In all health economies, there is a natural distribution of emergency demand and circulation of vehicle deployment around acute hospitals and as a result Lightfoot has developed an optimal deployment zone model based on this data. These deployment areas in turn show the most efficient distribution of crews and service models across an ambulance service's geographic catchment areas. As shown in Figure 4-3, the existing arrangement of dispatch desks currently used by NAS relates to the nine former health districts. As outlined in Section 7 below this configuration of dispatch areas results in a significant disparity in activity and resource across the different areas and consequently we believe that there is scope for NAS to obtain operational efficiencies by consolidating a number of these areas into larger dispatch areas. However, for the purposes of the current exercise we have used the existing dispatch desk structure to summarise and report the potential performance levels that NAS should be able to achieve and the resource requirements that are associated with the different levels of performance.

Figure 4-3: NAS dispatch areas

4.4 Rapid Response Vehicles (RRVs)

Rapid Response Vehicles play an important role in enabling ambulance services to ensure a high level of compliance with an 8 minute performance standard for high acuity incidents in the more densely populated urban areas. This is because they can be located with a high level of accuracy in those locations where there is the greatest likelihood of incidents occurring and are able to attend those incidents within 8 minutes in over 90% of occasions. In addition, RRV vehicles can also play an important role in the smaller urban centres by ensuring that there is a sufficient level of clinical resource available in the area to respond to high acuity incidents when the local ambulance is responding to another incident. This role for Rapid Response Vehicles is particularly relevant for NAS as in many locations an ambulance responding to an incident will be away from the area for an extended period of time. However, unlike the position in the more densely populated urban areas, the level of activity in the smaller urban centres is insufficient to keep a solo response resource fully occupied in responding to emergency calls alone. Consequently the introduction of a solo response resource in these areas would need to be structured as part of a broader primary care resource for the local community in the form of a community paramedic scheme or as part of a district nursing structure or local community hospital.

Recommendation

NAS should consider extending the use of Rapid Response Vehicles (RRVs) in both the major urban and minor urban areas.

4.5 Ambulance utilisation rates and overnight cover

The utilisation rate for a Double Crewed Ambulance (DCA) is a key consideration in determining the overall amount of ambulance resource that is required to run an emergency ambulance service. The utilisation rate is a measure of the ratio of the time that an ambulance spends responding to an incident expressed as a proportion of the total time that the ambulance is available to respond to incidents.

In most ambulance services, there is a clear correlation between rising DCA utilisation rates and a decline in performance. In our experience, it is unrealistic to rely solely on DCAs as the primary resource to respond to high acuity incidents requiring an 8 minute response in major urban and minor urban areas, as the utilisation levels that are required to enable emergency ambulances to perform at the required level would be too low to be economic. Consequently, our modelling is based on the assumption that 60% of high acuity incidents in urban areas will be responded to initially by an RRV, and that the remaining incidents (where an RRV is not available to respond) will be resourced by DCAs.

A consequence of this approach is that it is possible to plan for a lower count of DCA resource within the urban areas, as the utilisation level that is consistent with this level of performance can be higher than would be required if a DCA was the first response in the majority of cases. Nevertheless, although the use of RRVs allows DCA utilisation rates to be maintained at a higher rate than would be required

if all responses at 8 minutes were provided by DCAs, the rate still has to be maintained at a sufficiently low rate to enable the service to continue to meet the 19 minute transport standard.

In this context, it should be noted that DCA utilisation is sensitive to both demand profile and cycle time and this varies significantly between different deployment areas. In particular, whilst it is possible to plan for rates of utilisation in major urban areas of between 50 and 60%, it has to be maintained at a lower level in the lower activity areas. This is because the volume of activity overnight is significantly lower than it is during the day, but it is still important to be able to provide an adequate level of ambulance cover on a 24x7 basis in all geographic areas.

4.6 Potential performance levels using current resources

As Table 4-1 shows, in the six months between March and August 2014 NAS achieved an 8 minute performance level of 26.6% for Echo and Delta calls and a 19 minute performance level of 67.2% for Echo and Delta calls. However, as the table shows there was also a wide range of performance across the different deployment areas, with 8 minute performance in the major urban centres ranging from 59.1% in the North West to 24.6% in Dublin while 19 minute performance in the major urban centres ranged from 93.4% in the North West to 83.4% in the North East.

Table 4-1: Echo and Delta 8 minute and 19 minute performance by dispatch area and population density

	8 minute Echo/Delta				19 minute Echo/Delta			
Deployment area	Major Urban	Minor Urban	Rural	Total	Major Urban	Minor Urban	Rural	Total
Dublin/Wicklow	24.6	36.4	5.8	**23.4**	86.2	76.6	46.6	**78.9**
East Kildare		24.6	3.7	**15.2**		64.5	48.0	**57.2**
Midlands		47.4	3.9	**26.3**		84.6	45.6	**65.7**
Mid West	44.3	56.1	5.5	**30.6**	92.8	82.5	50.3	**73.3**
North East	53.1	44.1	7.1	**29.0**	83.4	77.3	50.4	**66.1**
North West	59.1	58.1	7.5	**28.4**	93.4	82.8	44.7	**61.9**
West	37.8	41.8	5.1	**20.5**	83.6	73.0	24.6	**48.0**
South	36.2	52.7	11.2	**29.0**	85.7	76.0	48.0	**69.1**
South East	41.5	50.7	5.0	**30.0**	93.1	78.3	38.7	**63.7**
NAS TOTAL	**36.7**	**45.6**	**6.6**	**26.6**	**87.0**	**76.7**	**44.0**	**67.2**

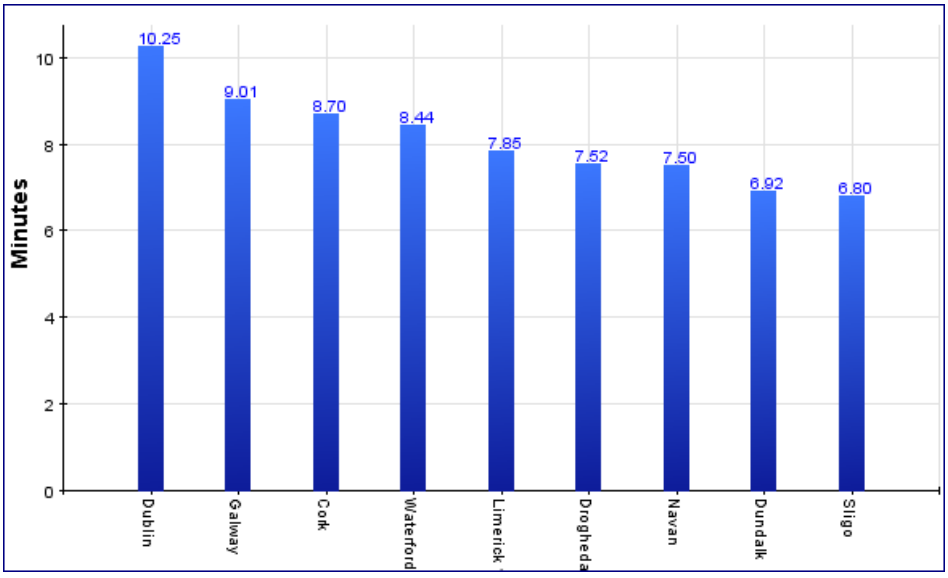
As Table 4-1 shows, there is a very significant gap between the levels of performance that NAS is currently achieving and the existing standards of 80% at the national level for 8 minute performance and 95% for 19 minute performance. Whilst we do not believe that it is realistic to expect NAS to achieve these standards (because of the highly rural nature of the areas that it services) the table also

highlights that there is scope for NAS to improve in both the major urban and minor urban areas where it should be possible to achieve a higher level of performance.

Whilst improving performance in these areas to the levels that other services achieve will undoubtedly require some additional resource as set out in Section 4.7 below, there are a number of factors which are limiting the ability of NAS to achieve a higher level of performance. These are unrelated to the available resource and, if they could be addressed, would significantly improve the level of performance that NAS could achieve with its current resourcing level. Key amongst these are the following:

- The time to allocate an incident to the responding resource and for the resource to become mobile takes significantly longer than in the case of other services which have more modern communication systems. We believe that, with the appropriate communication technology and deployment processes NAS could reduce the average time from the starting time of an incident to a resource becoming mobile from around 3 minutes at present to under 90 seconds
- When NAS resources are not responding to incidents they return to the ambulance station and are dispatched to subsequent incidents from the station. We have reviewed the location of these stations in each of the major urban locations where NAS operates and it is clear that they are not well situated for a quick response to high acuity incidents. In high performing ambulance services the average drive time to an incident from an optimal deployment point in a major urban centre is around 4 minutes. As Figure 4-4 shows, the median drive time for NAS resources attending Echo and Delta calls in the major urban centres ranges from 6.8 minutes in Sligo to 10.2 minutes in Dublin

Figure 4-4: Median drive times to attend Echo and Delta calls in major urban centres



This highlights the importance for NAS of reviewing its deployment practices within the major urban locations. It is clear that the current practice of deploying ambulances from the ambulance station results in an excessive drive time in the majority of the major urban centres. In most cases the speed of response to Echo and Delta calls would be improved materially by ensuring that an ambulance was deployed from a location closer to the centre of the urban area. (See Section 2.4.9 for further details.)

The impact of these changes on Echo and Delta performance which could be achieved without any additional resourcing is shown in Table 4-2. In particular, we estimate there is potential to improve performance in the major urban centres from 36.7% to 58.9% in the case of the 8 minute performance standard and from 87.0% to 90.4% in the case of the 19 minute standard.

Table 4-2: Potential Echo and Delta performance by dispatch area with improved response processes

	8 minute Echo/Delta				19 minute Echo/Delta			
Deployment area	**Major Urban**	**Minor Urban**	**Rural**	**Total**	**Major Urban**	**Minor Urban**	**Rural**	**Total**
Dublin/Wicklow	56.6	48.5	6.6	48.5	90.5	80.3	58.5	**84.3**
East Kildare		32.0	4.4	20.7		68.6	54.4	**62.4**
Midlands		64.5	4.5	45.2		84.6	53.4	**69.7**
Mid West	64.9	63.9	8.3	41.7	92.9	79.4	54.9	**74.8**
North East	64.8	57.5	9.0	37.2	89.8	80.6	61.9	**74.6**
North West	74.6	65.8	10.1	31.4	93.9	84.7	51.9	**65.9**
West	54.5	47.2	6.4	36.5	87.9	69.6	29.9	**52.0**
South	52.3	63.3	12.5	36.6	88.8	81.3	57.2	**74.7**
South East	59.8	58.4	4.9	24.8	93.9	74.5	43.6	**64.6**
NAS TOTAL	**58.9**	**50.1**	**8.0**	**35.7**	**90.4**	**77.6**	**51.1**	**70.9**

4.7 Best achievable performance using additional resource

As indicated in Section 4.4 above, the ability of NAS to achieve a further improvement in its 8 minute response performance to Echo and Delta calls in the major urban and minor urban areas will be primarily dependent on the availability of RRV resource. In major urban centres, RRVs can respond more quickly and at a higher rate of performance than DCAs. In minor urban centres, an RRV can remain in the locality and be available to respond when the local ambulance is involved in a prior response and is therefore out of the locality at the time that a subsequent incident occurs.

At the same time it will also be important to ensure that the DCA resource that NAS provides is used in the most effective manner. Based on these considerations, we have reviewed the current DCA and RRV resourcing provided by NAS. We have compared this with the optimal resource that we believe could reasonably be provided in order to achieve the highest level of performance.

The considerations that we have applied in determining the optimal resourcing for NAS are as follows:

- DCA resource should be supplemented with RRVs in the major urban centres at a level that will enable 60% of Echo and Delta calls to be attended by an RRV

- RRV resource should be made available to supplement a DCA resource in minor urban centres where the average level of daily activity for emergency and urgent activity exceeds 4 incidents per day and the average daily hours of work for DCA resource, exceeds 12 hours per day
- The average utilisation for DCA resource in major urban centres is assumed to be 55%. In minor urban centres where RRV resource is provided, DCA utilisation is assumed to be 45%. In other locations DCA resource is assumed to range between 40% and 30% depending on the average volume of activity in the area in question

Table 4-3 sets out the additional resource that would be required in each of the NAS deployment areas as a result of applying these assumptions to the current level of activity that is undertaken by the emergency ambulance resource. Following the introduction of ICVs, the majority of this work consists of emergency and urgent work, but it should be noted that a proportion of routine work is still undertaken by emergency ambulances and this has been included in the modelling that underpins this exercise.

Table 4-3: Additional hours required to achieve improvements in Echo and Delta performance

Deployment area	Current Ambulance hours (incl standby)	Current ICV hours	Current RRV hours	Additional Ambulance hours	Additional ICV hours	Additional RRV hours	Additional staff hours
Dublin/Wicklow	1944	410	40	629	50	632	**1989**
East Kildare	663	0	0	87	0	252	**426**
Midlands	2067	0	0	-336	50	420	**-152**
Mid West	1954	350	336	-222	0	-84	**-529**
North East	2014	220	0	84	0	504	**673**
North West	1739	345	78	497	0	258	**1252**
West	2627	390	168	584	0	336	**1505**
South	3261	480	336	860	0	168	**1888**
South East	2689	245	0	182	100	504	**1067**
TOTAL	**18958**	**2440**	**958**	**2365**	**200**	**2990**	**8120**

The implications of this additional resource for both 8 minute and 19 minute Echo and Delta performance is summarised in Table 4-4. This highlights that the primary effect of the additional resource is to improve the 8 minute performance on Echo and Delta calls in the major urban centres and in those minor urban centres where there would be sufficient activity to justify the addition of an

RRV resource that would be available to respond to incidents that occur whilst the local ambulance is occupied responding to another incident.

There is potential to improve performance from 35.7% to 51.2% in 8 minutes and from 70.9% to 81.5% in 19 minutes.

Table 4-4: Best achievable Echo and Delta performance by dispatch area with additional resources

	8 minute Echo/Delta				19 minute Echo/Delta			
Deployment area	Major Urban	Minor Urban	Rural	Total	Major Urban	Minor Urban	Rural	Total
Dublin/Wicklow	85.0	65.0	11.0	71.2	96.3	89.5	75.9	**92.3**
East Kildare	0.0	75.0	11.9	47.7		80.2	75.5	**78.1**
Midlands	0.0	72.4	8.0	41.2		87.8	76.7	**82.5**
Mid West	85.0	72.5	9.5	51.6	94.8	83.3	73.9	**84.0**
North East	85.0	76.8	10.3	44.8	94.4	88.7	77.4	**85.1**
North West	85.0	71.0	11.5	37.0	97.5	89.5	67.6	**77.0**
West	85.0	53.1	7.5	35.5	98.8	74.6	47.3	**63.4**
South	85.0	71.1	13.2	53.5	92.5	86.8	74.0	**84.4**
South East	85.0	69.0	7.2	44.0	97.4	80.4	65.8	**76.6**
NAS TOTAL	**85.0**	**73.2**	**10.1**	**51.2**	**95.5**	**84.06**	**69.3**	**81.5**

4.8 Potential improvements in rural 8 minute performance from the use of CFR schemes

As Table 4-4 also shows, the provision of the additional resource will only have a very small impact on the performance level that NAS would be able to achieve in the rural area as this consists of locations that are more than 5 km from the nearest NAS deployment point. Since the ability of NAS to meet the 8 minute performance standard depends upon a NAS resource being available within close proximity to an incident at the time that it occurs, it follows that the additional NAS resource will only have a marginal effect on 8 minute performance in rural areas.

In this context, it is important to emphasise the significant difference that NAS has in relation to the proportion of activity that occurs in rural areas by comparison with other ambulance services. As Table 4-5 shows, over 40% of the emergency activity in the area that NAS covers occurs in the rural area which is significantly higher than is the case in other services where it is unusual for the proportion of rural activity to exceed 30%. Moreover as Table 4-5 shows, in the West and North West deployment areas the proportion of activity that occurs in rural areas is 53.8% and 60.9% respectively.

Table 4-5: Proportion of activity in dispatch areas by population density

	Percentage of activity		
Deployment area	Major Urban	Minor Urban	Rural
Dublin/Wicklow	71.6	13.4	14.9
East Kildare	0.0	56.8	43.2
Midlands	0.0	51.5	48.5
Mid West	40.3	18.6	41.1
North East	35.4	13.4	42.7
North West	15.3	23.9	60.9
West	23.4	21.8	53.8
South	38.2	22.2	39.6
South East	13.4	42.7	43.9
NAS TOTAL	**32.6**	**25.9**	**41.5**

It should be noted, however, that a number of other ambulance services which also have a relatively high proportion of their activity in less highly populated areas do manage to achieve a significantly higher level of 8 minute performance in rural areas. This is achieved through the use of Community First Responder (CFR) schemes under which local communities acquire a defibrillator and establish and maintain response schemes that are able to attend high acuity calls within their local area. We understand that NAS does have a number of CFR resources who are informed about incidents in their local area, but does not currently have a formal process for establishing whether a CFR has attended, or for recording the time at which they arrived at the scene. Consequently, it is likely that the level of 8 minute response that is currently achieved in rural areas is somewhat higher than the levels that are included in Table 4-1 to Table 4-4.

Nevertheless, in order to achieve a significant improvement in rural performance NAS would need to identify those locations where there is a sufficient volume of emergency activity to justify the establishment of a structured CFR scheme and to ensure that these schemes were well resourced and supported. In general these will be small towns and larger villages where there are likely to be one or more Echo and Delta calls per week. It should be noted that the number of locations that meet this requirement and thus the potential for CFR schemes to improve the rural performance will differ from area to area depending on the population density and topographical makeup of the area in question. This is illustrated in the following heat maps of the distribution of one month's Echo and Delta incidents that occurred in the rural areas in the North East and North West Dispatch areas respectively.

Figure 4-5: Heat map of rural Echo and Delta calls in North East deployment area

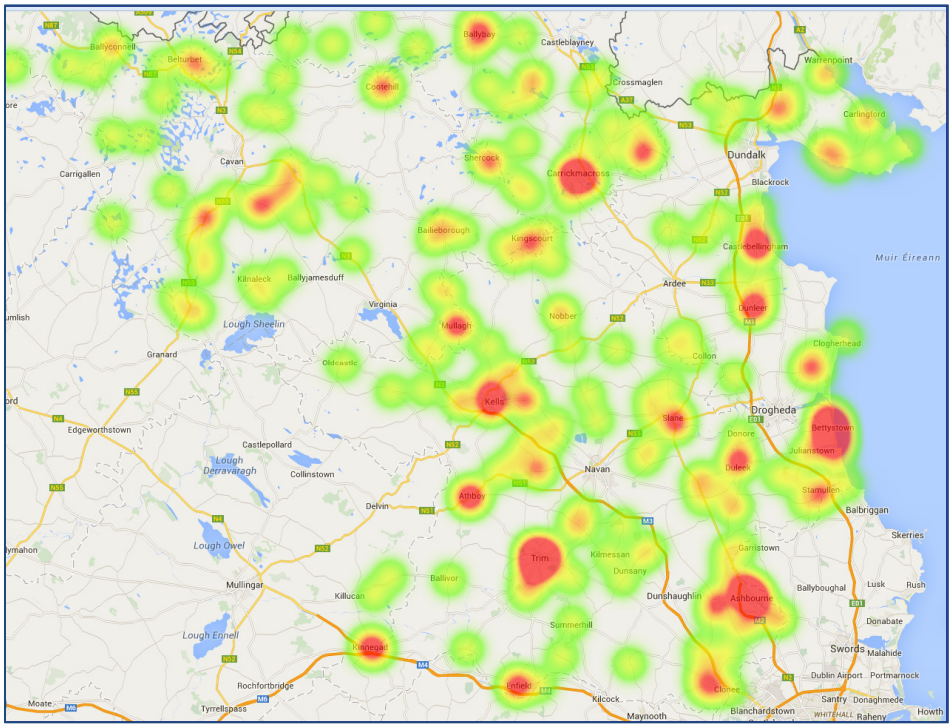
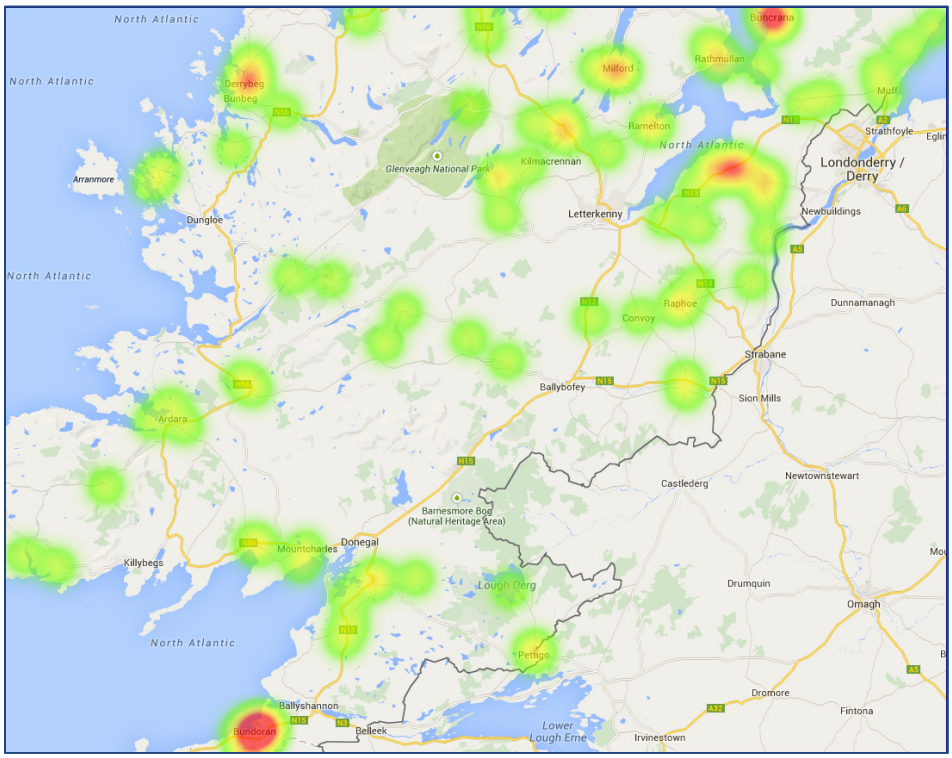


Figure 4-6: Heat map of rural Echo and Delta calls in North West deployment area



As these heat maps show, the activity in the North West is significantly more dispersed than in the North East and there are a smaller number of locations with a sufficient concentration of activity to

enable an active CFR scheme to have a predictable impact on 8 minute performance. Thus whilst in the North East it would be possible to plan to establish CFR schemes that would cover as much as 35 - 40% of the rural activity in the dispatch area, in the North West it would be difficult to cover more than 25% of the rural activity with such schemes.

We have undertaken an analysis of the number of locations where there is likely to be an average of one Echo and Delta call per week within each of the deployment areas listed as Appendix D to this report. Based on the assumption that CFR schemes in these locations would be able to respond to 70% of the incidents that fall within these areas within 8 minutes, Table 4-6 shows that the level of 8 minute performance in rural areas would improve from 10.1% to 32.9% and the overall level of 8 minute performance within the area covered by NAS would improve from 51.2% to 60.6%.

Table 4-6: Best achievable Echo and Delta performance with additional NAS resource and optimal CFR contribution in rural areas

	8 minute Echo/Delta				19 minute Echo/Delta			
Deployment area	**Major Urban**	**Minor Urban**	**Rural**	**Total**	**Major Urban**	**Minor Urban**	**Rural**	**Total**
Dublin/Wicklow	85.0	65.0	49.6	77.0	96.3	89.5	75.9	**92.3**
East Kildare	0.0	75.0	46.6	62.7		80.2	75.5	**78.1**
Midlands	0.0	72.4	28.4	51.1		87.8	76.7	**82.5**
Mid West	85.0	72.5	26.3	58.5	94.8	83.3	73.9	**84.0**
North East	85.0	76.8	33.8	54.8	94.4	88.7	77.4	**85.1**
North West	85.0	71.0	21.5	43.1	97.5	89.5	67.6	**77.0**
West	85.0	53.1	35.2	50.4	98.8	74.6	47.3	**63.4**
South	85.0	71.1	29.8	60.1	92.5	86.8	74.0	**84.4**
South East	85.0	69.0	24.4	51.6	97.4	80.4	65.8	**76.6**
NAS TOTAL	**85.0**	**73.2**	**32.9**	**60.6**	**95.5**	**84.06**	**69.3**	**81.5**

Recommendation

NAS should work with their volunteers to consider developing the scope of their network of community First Responder schemes to include some differentiated Delta calls (recognising this will require a major retraining programme), as well as increasing the number of schemes to cover many more areas, thereby improving patient care, clinical outcomes and response times in rural areas.

5 Resources and rostering

This section summarises the factors to take into account when determining the total number of staff that NAS would require to meet the improved performance standards that are set out in Section 4.

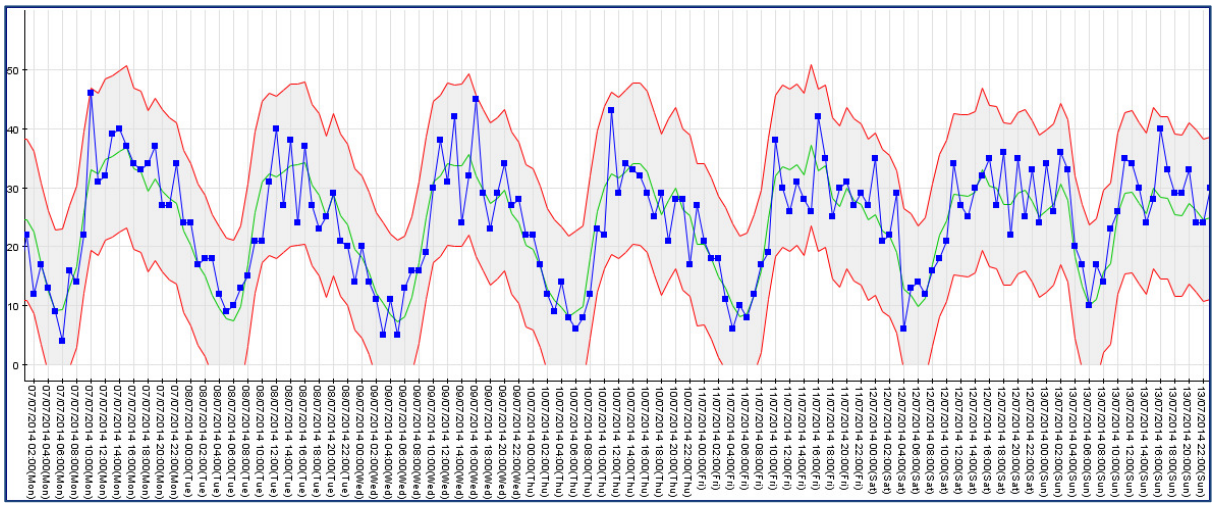
Please note that subsequent more detailed modelling was commissioned by NAS in March 2015, please see Appendix G for final resourcing implications.

5.1 Roster patterns

The roster patterns required to meet the demand that NAS faces will vary according to the time of day and the day of the week. As Figure 5-1 shows, the highest level of resource required is during the day on weekdays when NAS is responding to both routine and emergency calls, with the lowest resource being required between midnight and 8.00 am on weekdays when the volume of emergency incidents is at its lowest.

By contrast at the weekends the level of activity remains relatively high until between 2.00 and 3.00 am. Consequently NAS rosters need to ensure that resource is planned in a way that meets this variable pattern of demand throughout the week.

Figure 5-1: Typical hourly pattern of emergency and urgent activity throughout the week



Based on this pattern of activity, Table 5-1 sets out the roster hours that would be required in each of the nine current dispatch areas. As this highlights, a significant proportion of the cover between

midnight and 8.00 am in the dispatch areas with a significant rural component is currently provided by standby hours.

Table 5-1: Vehicle hours required to deliver improved performance by dispatch area

Deployment area	Ambulance weekdays - 08.00-00.00	Ambulance weekdays - 00.00 - 08.00	Ambulance weekend	Ambulance total	ICV weekdays	ICV weekend	ICV Total	RRV weekdays 00.80-00.00	RRV weekdays 00.00-08.00	RRV weekends	RRV Total
Dublin/ Wicklow	1507	524	555	**2585**	406	54	**460**	400	80	192	**672**
East Kildare	400	148	163	**711**	0	0	**0**	180	0	72	**252**
Midlands	937	409	436	**1782**	44	6	**50**	300	0	120	**420**
Mid West	801	432	469	**1702**	309	41	**350**	140	40	72	**252**
North East	1136	432	541	**2108**	194	26	**220**	360	0	144	**504**
North West	1009	520	549	**2078**	305	40	**345**	240	0	96	**336**
West	1818	665	727	**3211**	344	46	**390**	360	0	144	**504**
South	2087	945	1110	**4141**	424	56	**480**	320	40	144	**504**
South East	1769	582	654	**3005**	305	40	**345**	360	0	144	**504**
TOTAL	**11462**	**4657**	**5204**	**21323**	**2331**	**309**	**2640**	**2660**	**160**	**1128**	**3948**

5.2 Abstractions and relief

The level of relief that NAS builds into its resource plans is a critical factor affecting overall staff numbers and costs. An appropriate level of relief, therefore, has to be built in to resource planning to cover the normal levels of unavailability of staff as a result of factors such as holidays, sickness, training and other planned and unplanned absence as outlined in Table 5-2. It should be noted that the level of relief (i.e. the percentage of additional staff required to cover absences on planned rosters) is higher

than the level of abstractions because the staff who are employed to provide the relief factor on the rosters will themselves also be subject to the same abstraction rate as the staff who they are replacing.

Table 5-2: Components of abstractions and required relief rates

Components of Abstractions	Days per year	Abstraction percentage	Relief cover percentage
Total working days	260.7		
Public holidays	9		
Leave entitlement	25		
Sick leave @6%	15.6		
Maternity/ paternity leave @2%	5.2		
Other absences@0.5%	1.3		
Total (excl training)	**56.1**	**21.5%**	**27.4%**
Professional training	10		
Total (incl training)	**66.1**	**25.4%**	**34.0%**

This shows that the minimal level of absences that NAS needs to plan for as a result of unavoidable staff absence is 21.5%, which requires a relief factor of 27.4%. However this makes no provision for professional training which is particularly important for a service such as NAS that not only needs to maintain adequate levels of continuing professional training for its qualified staff, but also needs a development programme to upgrade staff to Advanced Paramedic status. In addition there will be an ongoing training requirement for staff in the control room in order to comply with the requirements for operating the AMPDS triage system.

The addition of a level of training of 10 days per year increases the abstraction rate from 21.5% to 25.4% and results in a relief factor of 34%. This is consistent with the level of relief that was recommended in the UK Office of Strategic Health Authorities paper 2007[13]. Based on these figures, we have, therefore, undertaken our analysis of the front line staff requirement for NAS based on the assumption of a relief factor of 34%.

The precise level of relief that will be required remains to be determined based on the detailed requirements that NAS has for training and workforce development and the most appropriate way in which this can be delivered.

[13] Good Practice Guide for Ambulance Services and their Commissioners – Office of the Strategic Health Authority 2007

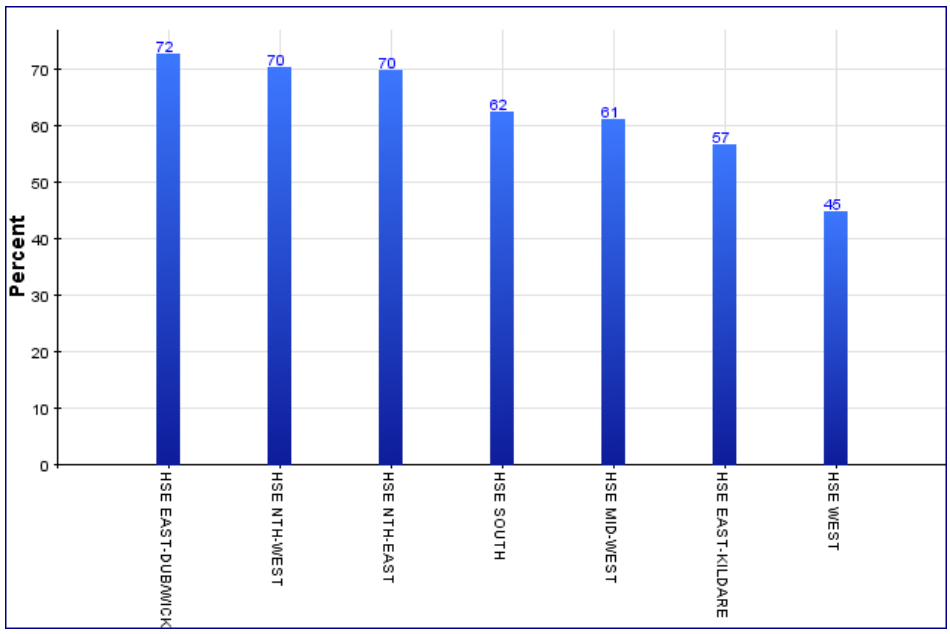
Recommendation

NAS should introduce a relief ratio of 34% as outlined in the framework in this report.

5.3 Deployment of Advanced Paramedics

NAS seeks to respond to high acuity emergency incidents with an appropriately qualified resource. As Figure 5-2 shows, the rate at which NAS currently responds to Echo and Delta calls with a vehicle staffed with an Advanced Paramedic varies from 72% in the Dublin and Wicklow dispatch area to 45% in the West dispatch area. (The data provided by NAS did not allow for this analysis to be undertaken in the South East and Midland dispatch areas.)

Figure 5-2: Percentage of Echo and Delta calls by dispatch area that receive a response from a vehicle staffed by an Advanced Paramedic



In this context, it should be noted that in the majority of the locations where NAS operates it may not be possible for NAS to establish a separate response plan that would enable a vehicle with an Advanced Paramedic to respond to high acuity calls, and a different vehicle with lower skilled staff to respond to other calls. Consequently we believe that it will be difficult for NAS to achieve full compliance with its objective of providing a full AP response to all incident codes identified by the Pre Hospital Emergency Care Council (PHECC).

Consideration should therefore be given to potentially developing a clinical model which provides as many RRVs staffed with Advanced Paramedics as possible and further work is undertaken to determine the best configuration of additional APs on strategically located ambulances. This would enable NAS to determine the optimal number of APs required and their deployment to ensure optimal compliance with the PHECC codes whist minimising skill decay for the AP group.

It should be recognised that this would be a long term project and would have significant cost and training implications. Early work should continue to focus on optimising the utilisation of the Advanced Paramedics already in post by ensuring that they are sent to appropriate calls wherever possible and are situated well geographically.

In the modelling which has been undertaken the AP and Paramedic required hours and staff have been combined. This provides a view of the number of clinically trained staff required to cover RRV's and emergency ambulances, allowing NAS to flex the modelling once the best clinical model has been identified.

Recommendation

NAS should give consideration to a programme of work which includes further sensitivity modelling as to the options for providing an Advanced Paramedic to those patients who require it within appropriate timeframes.

5.4 Front line resource requirement

Based on the assumptions set out in Sections 5.1–5.3 above, Table 5-3– Table 5-8 summarise front line hours and staff required to deliver best achievable performance with a 34% relief ratio and the appropriate staffing.

5.5 Current roster hours

Table 5-3 shows the current average weekly roster hours for September 2014.

Table 5-3: Current average weekly roster hours (by vehicle type)

Current roster	Ambulance	RRV	ICV	Av Weekly Total
Current roster hours	37918	958	4876	43752

5.6 Number of staff required to provide 34% relief ratio for the current rosters

Table 5-4 shows the number of NAS staff currently in post. It also shows the number of staff who would be required to cover the average weekly roster hours if the relief ratio was 34% (see section 5.1.2). To calculate the required staff in post from roster hours, we assume that you get 28 work hours per week on average from an employee. This is consistent with a 34% relief ratio and is a widely accepted standard. On this basis the table shows a shortfall of 181 staff between the number of staff in post and the number required to cover the roster at a 34% relief ratio.

Table 5-4: Number of current NAS staff and the number required to cover the rosters with a 34% relief ratio (by skill set)

	AP / Paramedic	EMT	Total
Current staff In post	1233	149	1382
Staff required for current rosters with 34% relief ratio	1395	168	1563
Short fall			181

5.7 Current overtime levels

Overtime for frontline staff in NAS is currently running at around 20% of the pay bill (information supplied by NAS - July 2014). If we assume that 10 % of that overtime is required to cover shift over runs and other similar reasons, that leaves 10 % of the pay bill that could be used to recruit extra staff. This sum equates to approximately 139 staff as shown in Table 5-5. It must be recognised that there would be other costs involved in recruiting these staff. These would include recruitment costs, training costs, uniforms etc. Nevertheless, if NAS did realise the staff from the existing overtime budget, then NAS would still required an additional 42 staff, to cover the 34% relief. (181 - 139 = 42).

Table 5-5: Estimate of the number of full time equivalent staff paid for by 10 % overtime levels (by skill set)

	AP / Paramedic	EMT	Total
No of staff paid for by 10 % overtime	117	22	139

5.8 Staff and roster hours required to deliver best achievable performance

Table 5-6 shows the roster hours that would be required for NAS to attain best achievable performance. (See Section 4.7)

Table 5-6: Average weekly roster hours to cover best achievable performance

	Ambulance	RRV	ICV	Total
Roster hours required to deliver **best achievable** performance	**42646**	3948	**5280**	**51874**

Table 5-7 shows the number of staff that would be required, at 34% relief ratio, to cover the best achievable performance roster hours of 51,874. This shows that NAS would need to employ 1853 staff, a further 290 over and above the number required to cover the current roster at a 34% relief ratio. The residual overtime savings of 42 staff could be used to offset some of these costs, reducing the net number of extra people to 332.

Table 5-7 also shows within the overall total of 1853 the skills mix that would be required to put an AP / Paramedic on every emergency ambulance and car.

Table 5-7: Number of staff required to cover best achievable rosters with a 34% relief ratio (by skill set)

	AP / Paramedic	EMT	Total
Staff required to deliver best achievable performance with 34% relief ratio	1664	189	**1853**

Table 5-8 shows the change in staff numbers required, compared to the current level, in order reach the best achievable performance with 34% relief ratio.

Table 5-8: Change in staff in post from current level to level required to cover best achievable rosters with a 34% relief ratio

	AP / Paramedic	EMT	Total
Staff changes to deliver best achievable performance with 34% relief ratio	**431**	**40**	**471**

6 Detailed modelling of the Dublin and Wicklow dispatch area

6.1 County Dublin emergency activity responded to by Dublin Fire Brigade (DFB)

The primary response to emergency calls within County Dublin is provided by the Dublin Fire Brigade (DFB). DFB responds to an average of 210 incidents per day, as is shown in Figure 6-1. This service is provided by DFB with a combination of 12 paramedic ambulances together with responses that are provided by other fire service vehicles which are also able to provide a fast response to emergency ambulance calls in County Dublin.

Figure 6-1: DFB number of emergency incidents

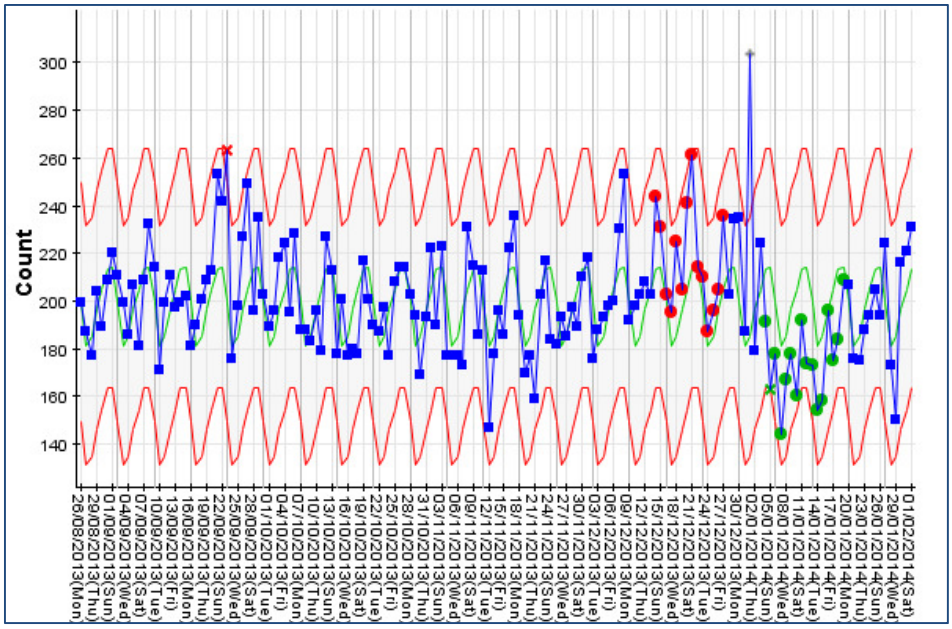
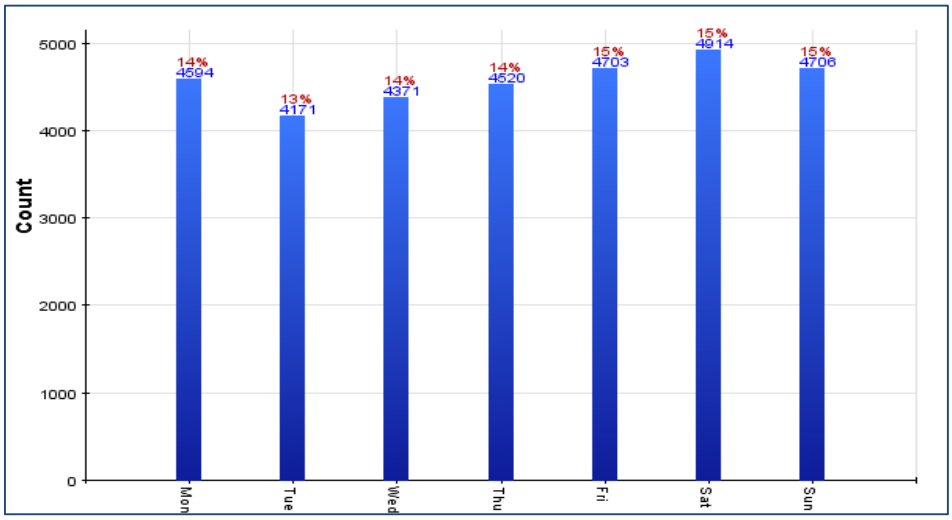


Figure 6-2 shows the number of DFB emergency incidents by day of week for the last year. These are relatively stable over the days of the week as would be expected for emergency calls.

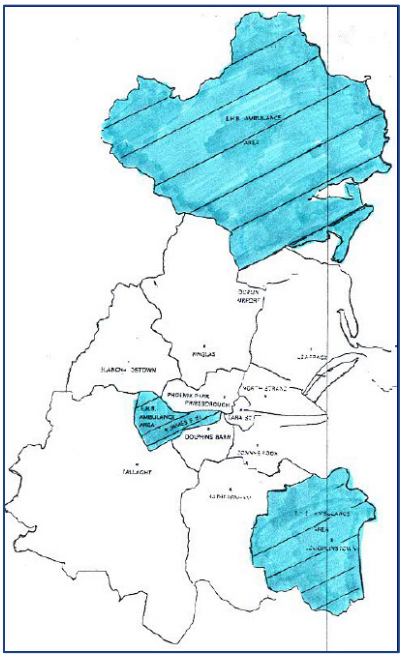
Figure 6-2: DFB number of emergency incidents by day of week



In addition to the response that is provided by DFB, NAS also responds to emergency ambulance calls within the County Dublin area under the following circumstances:

- Where an emergency call is for an incident that falls in the geographical area outlined in Figure 6-3, where it has been agreed that NAS will provide the responding vehicle
- Where DFB are unable to provide the response to an incident and NAS is able to provide a vehicle that can respond

Figure 6-3: Areas of Dublin where NAS provides the initial response to 999 calls



6.2 County Dublin activity responded to by NAS

As Figure 6-4 and Figure 6-5 show, the result of this arrangement is that NAS responds directly to around 55 emergency and urgent incidents within County Dublin. In addition it responds to an average of 30 incidents per day that are transferred to NAS from DFB.

Figure 6-4: Number of emergency calls in the County Dublin area that are responded to directly by NAS

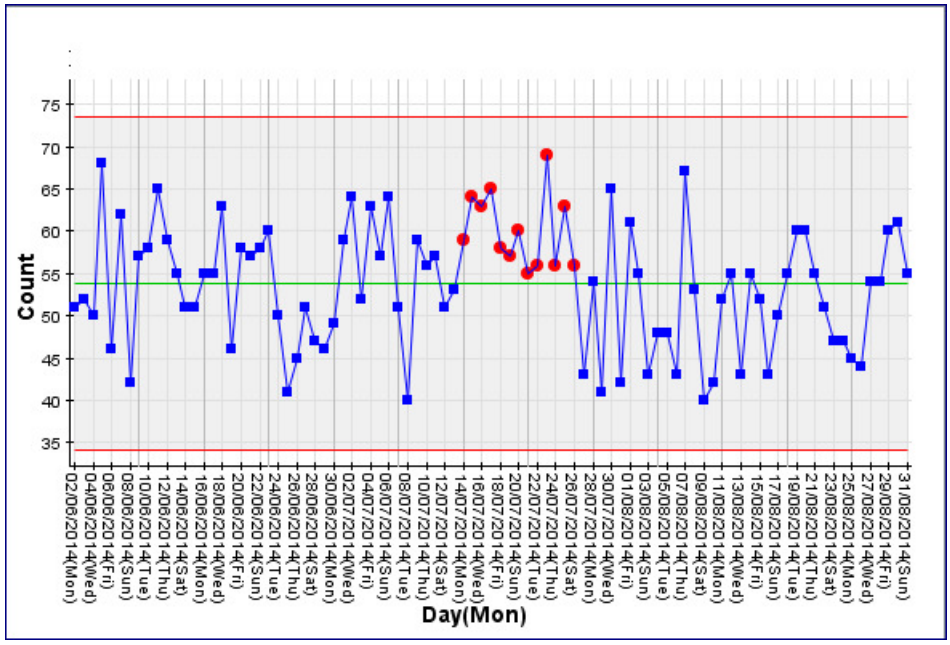
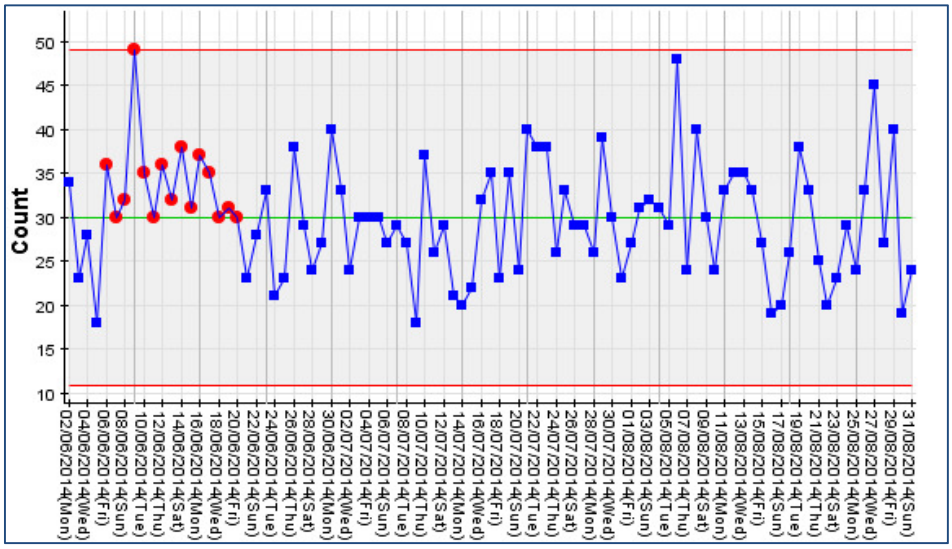


Figure 6-5: Number of emergency calls in the County Dublin area that are responded to by NAS following a transfer from DFB



6.3 Additional resource that NAS would need to handle the activity currently responded to by DFB

We were asked to calculate the resources NAS would require to handle the workload currently undertaken by DFB.

The key factor in estimating a service's potential ability to deliver performance is the call frequency by geographical area, based on categorising ambulance activity into major urban, minor urban and rural areas. This approach is considered in more detail in Section 2.3.3. From our experience of working with other services, we know that the best results that can be consistently achieved for the 8 minute standard are:

- 85% in major urban areas
- 75% in minor urban areas
- 40% in rural areas

Using our urban model (which is the most appropriate fit for Dublin County) we can determine the resources needed for the best achievable performance for this area. As previously referenced in Section 2.3.3, the areas are determined as follows:

- Major urban areas receive 6 or more emergency or urgent incidents per 24 hour period within a deployment area bounded by a 6-minute drive time (based at normal travel speeds) which equates to an area with a 5 kilometre radius
- Minor urban areas receive 1-6 emergency or urgent incidents per 24 hour period within a 6-minute drive time

In order to best manage the activity and response in the County Dublin area, it is recommended that one control centre should handle the activity in its entirety. This will allow for the control room to have full visibility of all incidents and resources and thus enable the rapid allocation of the closest and most appropriate resources to patients. It will also be necessary to implement arrangements to enable rapid allocation of DFB Fire Appliances to agreed incident types to support the ambulance provision.

6.3.1 Resource required for best achievable performance level in Dublin and Wicklow dispatch area

We recommend that NAS should strive to achieve the best achievable performance level in the urban areas as outlined above. We estimate that NAS would need a further 2507 ambulance hours per week and 588 RRV hours to perform the best achievable performance of 85% across the Dublin and Wicklow dispatch area, should they handle this activity in its entirety. Based on these figures, Table 6-1 summarises the extra hours required for NAS to handle the workload at a best achievable performance level, by vehicle type.

Table 6-1: Average weekly hours to cover DFB workload at 85% performance (by vehicle type)

	Ambulance	RRV	ICV	Total
Additional roster hours required by NAS to deliver best achievable performance in the Dublin and Wicklow dispatch area.	5014	588	0	5602

Table 6-2 shows the staff numbers and skill mix required for NAS to handle the Dublin and Wicklow as outlined above.

Table 6-2: Staff numbers to cover DFB's workload at 85% performance (by skill type)

	AP / Paramedic	EMT	Total
Staff required (with 34% relief ratio)	200	0	200

6.3.2 Sensitivity analysis of resource required for lower than recommended performance

We were asked to provide some sensitivity analysis around the additional resource NAS would require to handle the Dublin and Wicklow dispatch area activity in its entirety, performing at a rate of 60% for Echo and Delta incidents.

We estimate that NAS would need a further 2121 ambulance hours per week and 366 RRV hours to achieve a 60% performance level across the County Dublin area. These numbers are based on the following assumptions for NAS to perform at 60% in the Dublin and Wicklow dispatch area, and are calculated assuming no additional resource being available from additional funding.

The model assumptions are that ambulance utilisation at 65% will enable ambulances to perform at 50% for Echo and Delta, so NAS will need to rely on RRV performance of between 50% and 60% of the work in order to lift overall performance to 60%. This will require 4 RRVs running for 12 hours per day in the main areas of activity, which will respond to the remaining 40% of responses at 80-85% performance. This would give a total performance of 60%.

Based on these figures, Table 6-3 summarises the extra hours required for NAS to handle the Dublin and Wicklow activity in its entirety to perform at 60%, by vehicle type.

Table 6-3: Average weekly hours to cover DFB workload at 60% performance (by vehicle type)

	Ambulance	RRV	ICV	Total
Additional roster hours required to deliver 60% performance in the DFB area	4242	336	0	4578

Table 6-4 shows the staff numbers and skill mix required for NAS to cover the DFB workload at 60%.

Table 6-4: Staff numbers to cover DFB's workload at 60% performance (by skill type)

	AP / Paramedic	EMT	Total
Staff required (with 34% relief ratio)	160	0	160

6.3.3 Additional deployment points and resource modelling Dublin and Wicklow dispatch area

The following two sections are additional to the original final draft report 18th February 2015 and also form part of the amended version.

Following the initial modelling work set out above, we were asked to provide more detailed modelling for the deployment points and resources required across Ireland. This is dealt with in more detail in Appendix G. For the purposes of this section, 6.3.4 and 6.3.5 below set out the deployment points and resource required specifically for the Dublin and Wicklow dispatch area in a dual response model.

6.3.4 Detailed deployment modelling for a dual provision model across the Dublin and Wicklow dispatch area

The modelling assumes that in a NAS / DFB dual provision model, DFB would continue to provide their current levels of ambulance resourcing (12 * 24/7 DCAs).

We were asked to model the number of deployment points required across the Dublin and Wicklow dispatch area, as a whole for a dual provision response model. The analysis that underpins the recommendations in this study relating to optimal deployment points is based on a geospatial analysis (review of geography and number of calls) of emergency ambulance activity undertaken by both NAS and DFB. This analysis identifies all locations across Dublin where there is sufficient activity on a daily basis. These active areas that have more than 6 incidents a day justify the establishment of 6 minute drive zone isochrones from which a vehicle would be located to respond to the high activity area.

After the drive zone modelling it was determined that the Dublin and Wicklow dispatch area required 34 different 8 minute drive zones across the major urban and minor urban areas. In addition to these drive zones there were 5 separate 19 minute drive zones. Of the 34 areas that had sufficient activity (greater than 6 incidents a day), there were 15 key priority areas that we identified, which covered 90% of all the incidents in Dublin. Due to the large number of 8 minute drive zones (34), we decided to group them around acute hospitals and geographic features, so that RRVs could work to cover a number of drive zones. The DCAs would cover the 19 minute drive zones and to provide support for RRVs when they are engaged on incidents.

In addition to the above deployment modelling, it was further requested that we should provide the modelling of deployment points by the newly established NAS dispatch areas. The breakdown of the number of drive zones by dispatch area are provided in Appendix G.

See Appendix G for further details.

6.3.5 Detailed resource analysis for the Dublin and Wicklow dispatch area

This additional section has been requested to model the resource required to deliver the 85% standard across the major urban drive zones in the Dublin and Wicklow dispatch area. This develops the initial estimation of resources provided in the 18th February 2015 report.

We initially modelled the number of 8 & 19 minute drive zones, as mentioned above. This having been established we were then able to look at the demand profile by the day of the week, utilisation and

the length of the incident cycle time. We then determined the appropriate level of resource required in order to handle the activity in the Dublin and Wicklow dispatch area in its entirety.

This estimation exercise was undertaken based on aggregate level of activity within the Dublin and Wicklow dispatch area. The initial analysis started in 2014 did not request the level of detail in relation to the location of deployment points and the number of vehicles that would be required to provide geographic coverage.

This subsequent more detailed modelling identified 34 separate 8 minute drive zones across the Dublin and Wicklow dispatch area. This in turn resulted in a total requirement for 2016 RRV hours, together with 5243 DCA hours in order to deliver the best achievable performance of 85%.

Table 6-5: Average weekly vehicle hours modelled to cover the Dublin and Wicklow dispatch area

Dublin and Wicklow dispatch area	Ambulance	RRV	ICV	Total
Total hours modelled to deliver best achievable performance	5243	2016	460	7719

Table 6-6: Current average weekly vehicle hours provided to cover the Dublin and Wicklow dispatch area

Current Hours (2014 data) provided within the Dublin and Wicklow dispatch area	Ambulance	RRV	ICV	Total
DFB Current hours provided	2016	NA	0	2016
NAS Current hours provided	1944	40	410	2394

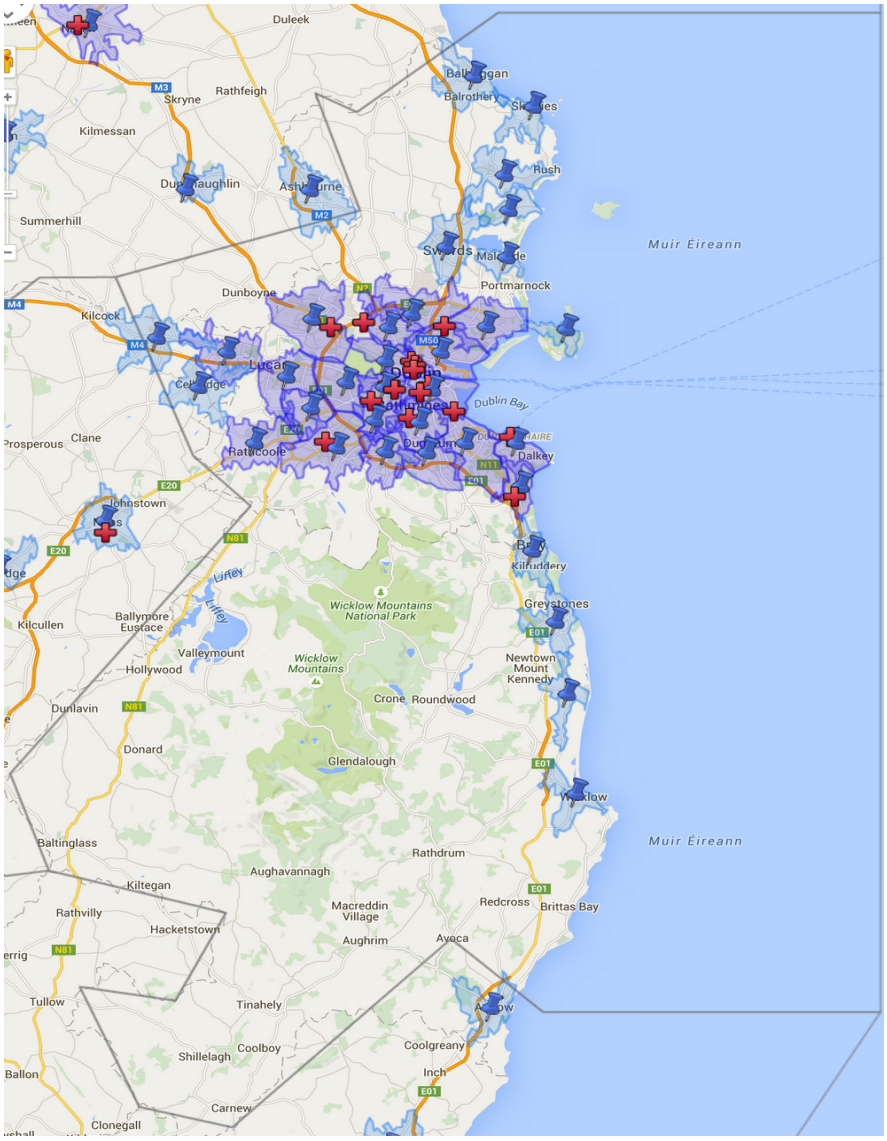
Table 6-7: Average weekly vehicle additional hours required to cover the Dublin and Wicklow dispatch area to deliver best achievable performance

Dublin and Wicklow dispatch area	Ambulance	RRV	ICV	Total
Remaining additional hours required to reach the modelled hours to deliver best achievable performance	1283	1976	50	3309

It is acknowledged that the current performance for Echo and Delta priority incidents in Dublin and Wicklow dispatch area, does includes incidents where the first arriving resource is a resource other than an Ambulance dispatched by DFB. The terms of reference for this review and modelling do not include analysing and commenting on the performance of incidents currently handled by DFB resources, therefore it is not possible to comment on the actual performance contribution of the other DFB resource types. The use of “co-responding”, particularly in the case of Echo calls is good practice, however it is recommended that this should be “added value”, rather than being part of the core response model to achieve the required Echo and Delta performance. For ambulance services to achieve the required response time performance, they must be able to accurately forecast activity and ensure that deployment points are covered. To rely on other DFB resource types such as fire appliances to cover deployment points would not be considered a best practice model, as it is unlikely to be guaranteed that these resources will always be available in the locations required to respond to

ambulance incidents. In this context the modelling of resource required to meet performance for the Dublin and Wicklow dispatch area does not take into account the level of performance that could be achieved by other DFB resource types responding to ambulance incidents where they are the first arriving resource. This consequently explains why there is an uplift in required RRV hours relative to the RRVs hours shown in Table 6-1 above.

Figure 6-6: Map showing the location of recommended 8 minute drive zones in the Dublin and Wicklow dispatch area.



Further to this modelling we have provided the resource requirements for an additional 6.5% emergency activity growth (section 2.3.2) by the newly establish dispatch areas.

See Appendix G section 18 for further details.

7 Control room

7.1 Overview

NAS have been working through a significant change to both the structure and technology infrastructure of the control rooms through the National Ambulance Service Control Centre Reconfiguration Project (NASCCRP). It should be acknowledged that the implementation of a single control infrastructure across two sites is an example of best practice and the right thing for NAS to do in order to better support a National Ambulance Service model.

The move from multiple control rooms to two sites is a significant change, the scale of which should not be underestimated. The modelling for the two site configuration is based upon the full implementation of appropriate technology and infrastructure, it will be necessary for NAS to phase the staffing until the programme is fully implemented.

7.2 Resources

NAS currently organises its dispatch process based on the nine former health district areas[14]. However, as Table 7-1 shows this results in a very marked disparity in the activity that occurs on a daily basis in each of the dispatch areas as well as in the quantity of resource that needs to be managed by each dispatcher. Thus, for example, while the dispatch desk covering the South dispatch area currently manages 23 resources and an average of 90 incidents per day, the desk covering the East Kildare region only manages 31 incidents per day and a total of 6 resources.

Table 7-1: Workload and resources by current dispatch desks

Dispatch desk resources and activity						
Deployment area	**Max number of ambulances (current)**	**Max number of RRVs (current)**	**Max number of ambulances (future)**	**Max number of RRVs (future)**	**Total incidents per day**	**Incidents per ambulance (future)**
Dublin/Wicklow	13	1	16	6	100.4	6.3
East Kildare	5	1	5	3	31.1	6.2
Midlands	13		13	5	46.4	3.6
Mid West	12	2	10	2	38.9	3.9
North East	14		14	6	71.9	5.1
North West	12	2	14	4	36.2	2.6
West	18		21	6	68.2	3.2
South	21	2	25	5	90.2	3.6
South East	17		18	6	81.0	4.5
NAS TOTAL	**125**	**8**	**136**	**43**	**564.3**	**4.3**

[14] National Ambulance Service Control Centre Reconfiguration Project 6th June 2012

7.3 Dispatch desk workload

In our experience, the key factor in determining the scope of a dispatch desk is the number of incidents that can be managed in the course of the day, together with the number of resources that are available and need to be managed from the desk. In general, it can be assumed that a dispatch desk should be capable of managing up to a maximum of 20 incidents per hour at peak workload, and between 25 and 30 resources, with an average workload per ambulance of between 10 and 12 incidents per ambulance per day. This is with best practice technology deployed and it should be pointed out that a higher number of staff will be required until all appropriate systems are fully embedded.

As Table 7-1 shows the current workload for each of the NAS dispatch desks is significantly lower than the level we would regard as optimal for a fully resourced desk with the appropriate technology, and we believe that there is considerable scope for establishing a more effective structure for dispatching the urgent and emergency activity. This is evidenced in Figure 7-1 and Figure 7-2 which show the hourly pattern of activity in a representative week in the Dublin and Wicklow and Midlands dispatch regions.

Figure 7-1: Hourly emergency and urgent activity handled by the Dublin and Wicklow dispatch desk

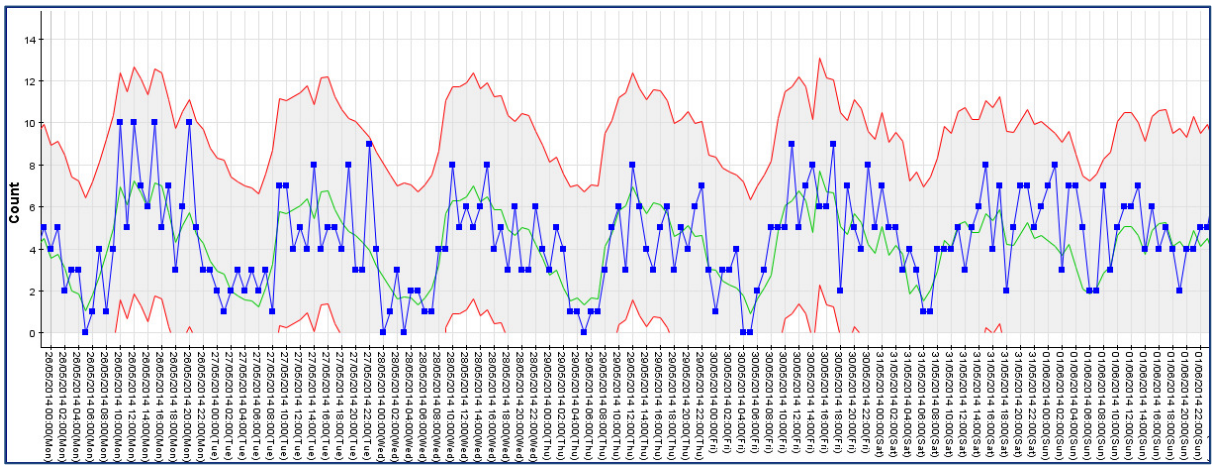
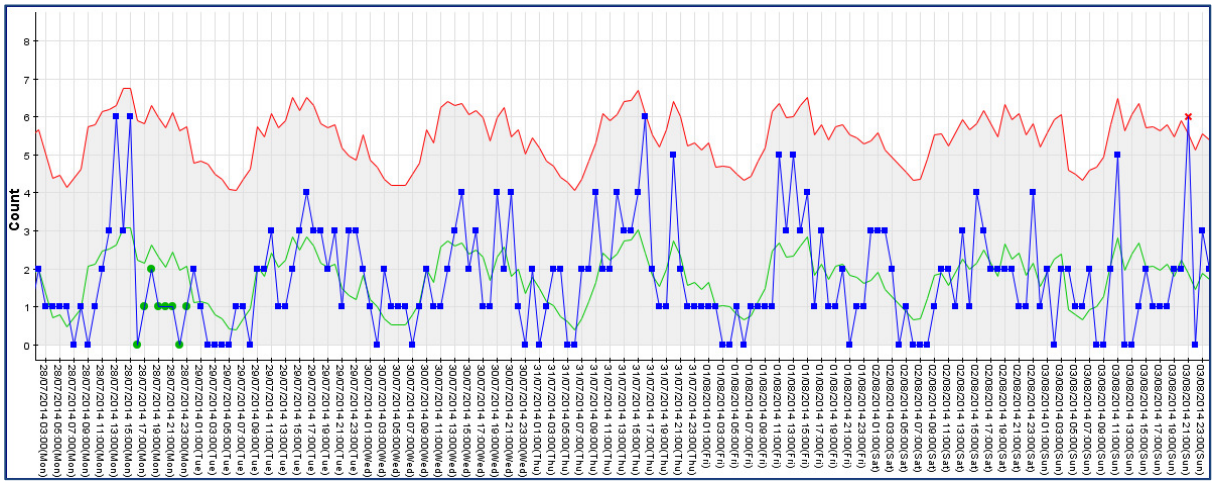


Figure 7-2: Hourly emergency and urgent activity handled by the Midlands dispatch desk



In view of this variation in the level of activity in the different dispatch areas, Table 7-2 sets out an alternative configuration of dispatch desks which could be achieved by merging the North East and East Kildare dispatch areas, and the Midlands and Mid West dispatch areas from the current four desks into two dispatch areas. This results in a new dispatch desk structure consisting of seven desks.

Table 7-2: Workload and resources by potential future dispatch desks

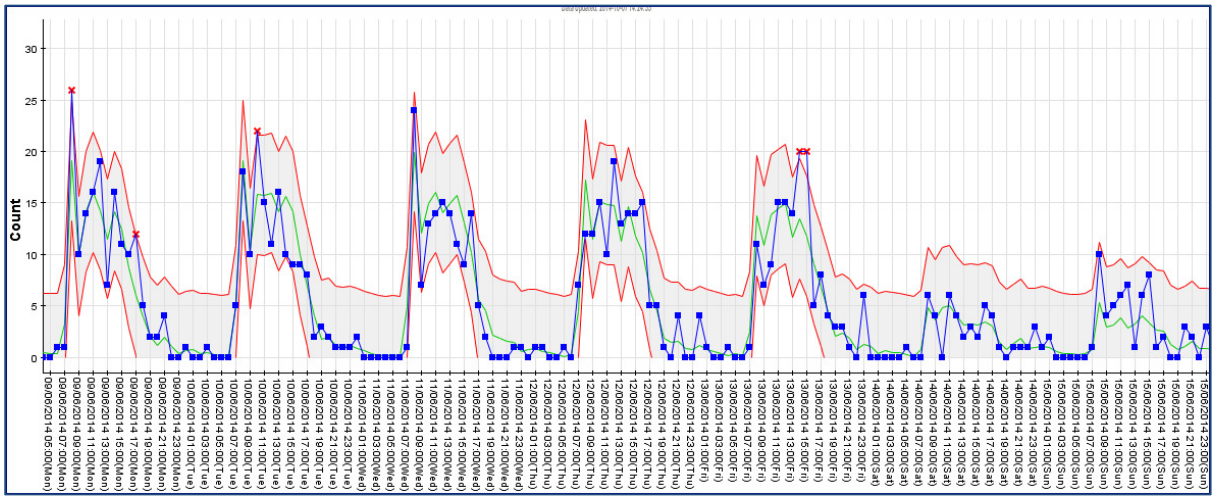
	Dispatch desk resources and activity			
Deployment area	**Max number of ambulances (future)**	**Max number of RRVs (future)**	**Total incidents per day**	**Incidents per ambulance**
Dublin/Wicklow	16	6	100.4	6.3
North East East Kildare	19	9	103.0	5.4
Midlands Mid West	23	7	85.4	3.7
North West	14	4	36.2	2.6
West	21	6	68.2	3.2
South	25	5	90.2	3.6
South East	18	6	81.0	4.5
NAS TOTAL	**136**	**43**	**564.3**	**4.1**

A further consolidation of dispatch desks should also be achievable for the period between midnight and 8.00 am on weekdays when a maximum of four desks should be able to manage the overnight activity. A four desk configuration overnight would need to be appropriately spread across the two sites to allow the necessary fall-back arrangements. Once again it will only be possible to consider this option once best practice levels of technology are available.

In addition, we have assumed that NAS will continue to manage the workload of routine activity through a single desk that manages all bookings for Intermediate care vehicles within normal working hours, and if necessary also will provide requests for overflow work to be undertaken by emergency ambulances. Figure 7-3 shows the daily pattern of routine activity by time of day which indicates that the peak volume of routine calls is around 20 calls per hour. Based on this data we believe that NAS

would be able to manage the routine bookings function on one desk with two members of staff between 8.00 am and 6.00 pm on weekdays and one member of staff at weekends

Figure 7-3: Hourly pattern of routine calls



7.4 Emergency call taking

In addition to the call dispatch process, NAS needs to have sufficient staff to respond to the emergency calls that it receives. In order to estimate the number of call handlers that are required to respond to these calls within a required performance standard it is necessary to know:

- The total number of calls received by time of day
- The desired performance standard for responding to these calls (e.g. 95% of emergency calls responded to within 5 seconds)
- The average length of time that it takes to respond to a call, as well as the variation in this time

In this context, the data that we received from NAS did not include the detailed information from a call handling system that would allow us to estimate accurately either the call volume, or the length of time that NAS's call handlers take in responding to these calls. In estimating the number of call handlers that NAS will require in the Control Centre, we have therefore had to make a number of assumptions about the call handling process. These are as follows:

- NAS receives 1.2 calls for every incident that it responds to
- The call length in responding to these calls varies between 275 seconds and 350 seconds
- The target performance standard is that 95% of emergency calls will be responded to within 5 seconds

Using these assumptions we estimate that NAS would require a total of 14 call handlers during the day and 8 call handlers overnight to meet the required performance standard.

7.5 Staffing profile

As set out in Table 7-1 above the numbers of staff for emergency control rooms is clearly dependant on having the right technical infrastructure and processes in place. It is also important to ensure the staffing levels allow for appropriate resilience between the two sites, particularly in the context of an immediate site evacuation scenario.

Table 7-3 sets out the number of staff that we believe NAS would need to provide the core Control Room processes, based on the following assumptions of NAS requirements and best practice technology in place:

- One Duty Control Manager at the primary centre 24/7
- One Duty Team Leader at the secondary centre 24/7
- Two Team Leaders on day shifts 12/7 at the primary centre (one for call handling and one for dispatch) and one Team Leader at night.

Table 7-3: Control room staff required to resource recommended processes

	Monday - Friday	Weekend	Total hours	Staff numbers
Dispatcher hours	720	336	**1056**	**37.7**
ICV desk hours	100	20	**120**	**4.3**
Call handler hours	1320	528	**1848**	**66.0**
Supervisory hours	420	168	**588**	**21**
TOTAL	**2560**	**1052**	**3612**	**129**

Our initial analysis suggested that there is scope to rationalise the number of dispatching desks from nine to seven taking into account NAS requiring the appropriate technology and processes. The above staffing numbers are based on this premise. It should also be noted that in the event of a dual provision model for the Dublin and Wicklow dispatch area (East), where all resources and incidents are deployed to by NAS, an additional dispatch desk will be required, which will affect the above staffing numbers.

Recommendation

NAS should review the number and structure of the dispatch desks, operating processes and the control room staffing arrangements.

8 Further efficiencies

We have commented on potential efficiencies in NAS processes as we have gone through the various sections in the report. For example, we have identified improvements in job cycle time, allocation, mobilisation and drive times. We also identified scope to rationalise control room operations and save money. However, the Terms of Reference invited us to report on any other areas where we felt further efficiencies may be gained. Two possibilities stand out – Hear and Treat and See and Treat.

8.1 Hear and Treat

As we noted earlier in the report, ambulance services around the world are facing ever increasing demands on their services. Many are choosing to respond to this by developing a stronger clinical presence in their control rooms so that, where appropriate, they can offer clinical advice over the phone to patients rather than send an ambulance. In England, for example, all ambulance services now offer this facility. On average, they are now responding to about 7% of calls with telephone advice. The telephone advice can either be self-care or guidance on alternative care pathways.

There is scope to support paramedics on the clinical desk with doctors and nurses which will help to share experience and expertise.

Not only does this facility offer more appropriate care for patients, but it also offers a substantial saving in costs in terms of reduced responses to ambulance services. Clearly appropriate governance, training and support is required to ensure a safe service but the processes to achieve this are now well tried and tested in England.

Recommendation

NAS should consider setting up a clinical support desk in the control room to offer a Hear and Treat service to appropriate patients.

8.2 See and Treat

NAS convey the majority of their patients to a hospital. Most ambulance services around the world are now trying to adapt their practices to take to A&E only those patients for whom that will be the best place for treatment. This approach has potential benefits all round. Patients will receive more appropriate treatment often in a more convenient location, either at or nearer their home. The health system will benefit as fewer patients are taken into A&E departments, with the associated possibility that they will be admitted to hospital. The ambulance service can share in these financial benefits as well as providing a more rewarding environment for their staff, who often welcome the extra skills they acquire to discharge this extra responsibility. .

However, the ability of the NAS to do the same has a number of limitations at present, some which are well understood, i.e. the lack of alternative pathways available in the community setting and others which are less well understood, i.e. the low number of calls to the ambulance service in Ireland

(when compared internationally). Both these factors will influence how NAS can respond to calls which in other ambulance services internationally would be part of a See and Treat cohort.

The provision of alternative care pathways is likely to begin to be possible as the Integrated Care programmes develop. It is essential that the NAS is heavily involved in the ongoing development of these care pathways.

The low call numbers to the ambulance service needs to be better understood to determine whether there are potentially less people calling ambulances in Ireland than elsewhere who might benefit from a See and Treat approach due to their higher threshold in calling for assistance.

We would suggest that the NAS and the National Hospitals Office undertake some further work to understand the groups of patients who are being transported to hospital and whether any of them would benefit from a See and Treat approach as there are clear benefits to patients in this system.

If this system is adopted then appropriate governance, training and support is required to ensure a safe service and the clinical support desk mentioned above can play a key role in providing clinical advice to NAS staff when they are with patients.

Recommendation

NAS, in partnership with the wider health system, should review its policy of taking all patients to A&E and consider developing a See and Treat approach.

9 Risks and sensitivities

There are a number of key reforms and challenges across the HSE that may impact on the provision of services by NAS. These include:

- Reconfiguration of the acute hospital sector into Hospital Groups
- Provision of critical care in Model 4 and Model 3 hospitals only
- Introduction of a National Paediatric Hospital
- Population demographic changes, particularly the increase in the numbers of older people

9.1 Hospital Groups

In 2013, the Minister for Health announced a programme to establish a number of Hospital Groups across Ireland, which are seen as a transition phase towards independent hospital trusts. Two reports were issued simultaneously, describing the introduction and implementation of a Hospital Group structure and the Smaller Hospitals Framework:

- Each Hospital Group will be made up of between six and eleven hospitals, and include at least one major teaching hospital. Each group will maintain a key academic partner to ensure high calibre training and education is core to their aims
- Smaller hospitals will be supported within the Hospital Group in terms of education and training, continuous professional development, sustainable recruitment of high quality clinical staff, and the safe management of deteriorating and complex patients

The aim of the Hospital Groups was to work to deliver high quality, safe patient care in a cost effective manner. As the Hospital Groups develop they will determine the best configuration of their services, and so there will necessarily be impacts on NAS as patients are directed to particular hospital sites for particular services and treatments. This impact will be across all the services NAS provides – emergency, intermediate care and routine. The Intermediate Care Vehicle (ICV) provision will need review to ensure that ICVs are linked to the work of the Hospital Groups; this may not be about extra resource but may be about where these vehicles are situated. It is vital for NAS to ensure it is included in the planning of these changes and to help shape the discussions.

9.2 Critical care

The National Clinical Care Programme for Critical Care has recently published and begun to implement its findings with regards to provision of critical care services across the various hospital models and groups.

The numbers of patients involved will be small, but there will be an impact on NAS because of the high acuity and intensity of provision required. NAS needs to ensure it can respond appropriately to this group of patients, by providing high quality resources. These resources include the necessary staff and vehicles.

9.3 National Paediatric Hospital

Earlier this year the final announcement for the site and development of a National Paediatric Hospital was announced. This Hospital will combine three sites currently spread across Dublin and will provide both regional and national speciality services, as well as local emergency and elective care for the children of Dublin and Ireland.

NAS will need to ensure that it is involved in early discussions about the configuration of services in the National Hospital and about the impact on services as current sites relocate and as regional and national specialties are imported into the Dublin site. NAS will need to ensure that its protocols and policies for the transport of neonates and children continue to be relevant in the new arrangements and also that it has clear protocols in place with the main Maternity hospitals and units in particular.

9.4 National Clinical Care Programmes

The National Clinical Care Programmes continue to work on developing new pathways of care and enhanced ways of working. A number of key programmes have moved into an implementation phase and the NAS have been involved in a number of developments and changes to their services to support these programmes.

A number of other programmes, such as the Care of the Older Person are in the early stages of work for the pre and post hospital phase of any intervention with the older person. Clearly NAS can have a key role across the whole pathway of care for the older person and this may be an area for future developments and role extension for paramedics.

There are already a number of initiatives designed to ensure best practice service provision, such as the Treat and Referral guidelines, Appropriate Hospital Access Programme and so on. These types of best practice initiatives need to be promoted and clinically audited to demonstrate their impact on the best clinical outcomes for patients.

NAS should continue to react to the clinical and operational challenges it will face and should be proactive in assuring its position in the patient care pathway. There are good examples internationally of the progress that ambulance services can make, from being purely a transport provider to being a key provider of care in a patient's clinical care pathway.

NAS is currently at the beginning of this phase of transition and will need to develop a strong strategic vision as well as an operational one, driven by the clinical needs of its population and supported and monitored with the utilisation of good data and analysis.

9.5 Community Health Organisations

In addition to the developments across the acute sector there are also key changes within the community services, with the aim of introducing a more integrated approach to care in the community setting. The recent review of community services has proposed the establishment of a number of Community Health Organisations (CHOs) which will link the work of primary care, social care, health and wellbeing and mental health at a local level. They will be supported by Primary Care networks.

NAS will again have a crucial role to play in all of these changes and improvements to the services for patients and can be a key provider and supporter of care in the community setting.

10 Summary of all recommendations

(Listed chronologically as they appear in the report, not in priority order)

	Recommendation	Section
a	NAS should undertake further investigation into why emergency calls per head are so low in Ireland compared to England, so that future patterns of growth in Ireland can be better understood and accommodated.	2.2.1
b	NAS should work with partners in the Irish health system to establish an agreed basis for handling routine activity (inter-hospital transfers of patients) with improved utilisation of ICVs.	2.3.2
c	NAS should build on the HIQA National Standards for Safer Better Healthcare and develop a suite of appropriate clinical outcome and patient experience measures.	2.4.1
d	NAS should consult with HIQA on a review of response time targets, in the light of the conclusions of this report about their achievability.	2.4.1
e	NAS should invest in technology to support a more systematic approach to performance management and continuous improvement to enable full staff engagement.	2.4.11
f	NAS should review its vehicle allocation processes with the aim of reducing the time from call determinant (identification of patient complaint) to vehicle allocation from 100 seconds to 45 seconds (although full achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).	2.5.3
g	NAS should introduce a process for earlier identification of, and dispatch of a vehicle to, Echo (immediately life threatening) calls.	2.5.3
h	NAS should review its vehicle mobilisation processes with the aim of reducing the time from allocation to vehicle mobile from 80 seconds to 45 seconds (although full achievement of this target will be dependent on the completion of the investment in new technology and the control rooms).	2.5.4
i	NAS should undertake a review of all vehicle deployment points in both major and minor urban areas to reduce drive times, aiming for an average drive time of 4 minutes in major urban areas. (See Appendix E for proposed major urban deployment points).	2.5.5
j	NAS should work in partnership with identified hospitals to reduce the time spent by ambulances at hospital and ensure safe handover of patients.	2.5.8
k	NAS should consider extending the use of Rapid Response Vehicles (RRVs) in both the major urban and minor urban areas.	4.4
l	NAS should consider developing the scope of their network of Community First Responder response to include Delta calls (recognising this will require a major	4.8

	Recommendation	Section
	retraining programme), as well as increasing the number of schemes to cover many more areas, thereby improving patient care, clinical outcomes and response times in rural areas.	
m	NAS should introduce a relief ratio of 34% as outlined in the framework in this report.	5.2
n	NAS should give consideration to a programme of work which includes further sensitivity modelling as to the options for providing an Advanced Paramedic to those patients who require it within appropriate timeframes.	5.3
o	NAS should review the number and structure of the dispatch desks, operating processes and the control room staffing arrangements.	7.5
p	NAS should consider setting up a clinical support desk in the control room to offer a Hear and Treat service to appropriate patients.	8.1
q	NAS, in partnership with the wider health system, should review its policy of taking all patients to A&E and consider developing a See and Treat approach.	8.2

11 Appendix A – Objectives

Objective
1 Support with data collation from multiple CAD sources in the required format
2 Understanding of organisational context and gain insight into NAS
3 Forming relationships with key NAS project members
4 Analysis of historical ambulance emergency and non-emergency demand for the previous three years (CAD data allowing)
5 Modelling future demand going forward to 2019 based on the above analysis and agreed assumptions designed to take into account the impact of the future health service configuration in Ireland
6 Analysis of the current ambulance call cycle and response time performance
7 Present baseline findings to AACE/ NAS
8 Modelling the response time performance which can be achieved using existing resources against the pre-determined optimal rostering and deployment regimes
9 If there is a performance shortfall, modelling the additional resources which would be required to consistently deliver target response time performance for all types of calls
10 Analysis of the current and projected resourcing levels for emergency ambulance cover and for Intermediate Care
11 Modelling the optimal rostering patterns going forward to achieve best possible use of existing resources
12 Determining the optimal deployment regime for both Fast Response Units and Ambulances
13 Modelling the NAS resource required to absorb the ambulance provision currently provided by Dublin Fire Brigade
14 Modelling the amount of overall relief cover required both operationally and within the control room environment
15 Conducting sensitivity modelling to understand the impact of a range of factors such as changes in demand or response time targets
16 Model and report any other areas in which it is felt further internal efficiencies may be gained
17 Report Creation
18 Modelling the resource requirements for the revised national control room configuration

Following the draft report Lightfoot was commissioned to conduct more in depth modelling and set out the deployment points and resource requirements at a granular level. This further work commissioned in March 2015.

Further Objectives – March 2015
1 Model the optimal deployment points and associated resource that would enable NAS to achieve the optimal performance at both 8 minutes and 19 minutes in both the major urban and minor urban locations
2 Extend the analysis in the report to identify the deployment locations and the associated resource that would be required to achieve the optimal 8 minute performance level of 85% across the whole of the Dublin and Wicklow dispatch area.
3 Model the implications of a dual response model provided by both NAS and DFB in the Dublin and Wicklow dispatch area (East) taking into account a 6.5% uplift for the 2015 year.

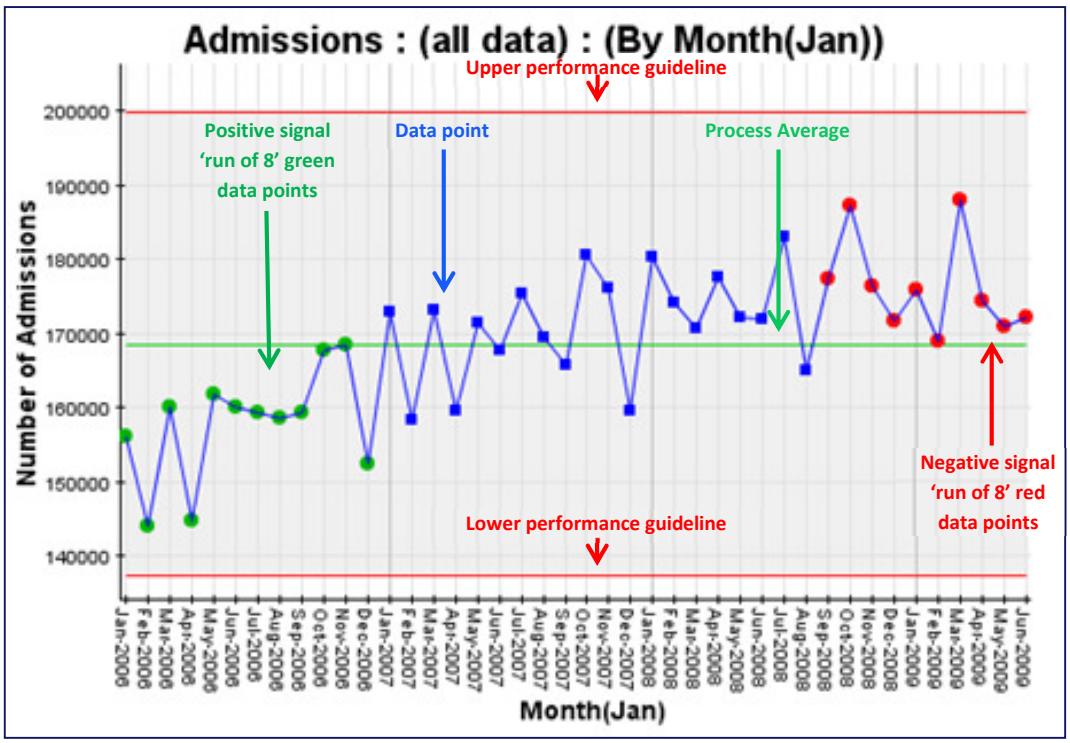
12 Appendix B - How to read sfn charts

12.1 sCharts

An sChart (also known as a Control chart) shows the history of data for a measure plotted against time (or some other logical ordering of the data). It is useful to identify trends, cycles and variability. The gap between the upper and lower performance guidelines is known as the performance corridor which shows the range of 'normal' values and the 'variation' of the measure. The wider the corridor, the more variability and therefore the more unpredictable the process; unpredictable processes are difficult and often expensive to manage.

The sChart may be used to distinguish between signals and noise, where signals represent significant features in the data that you can be confident are really worth investigating. Figure 12-1 exemplifies 'run of 8' signals – where at least 8 data points have occurred on one side of the average line and hence a statistically significant change has occurred in the process. Positive signals are indicated in green and negative signals are indicated in red.

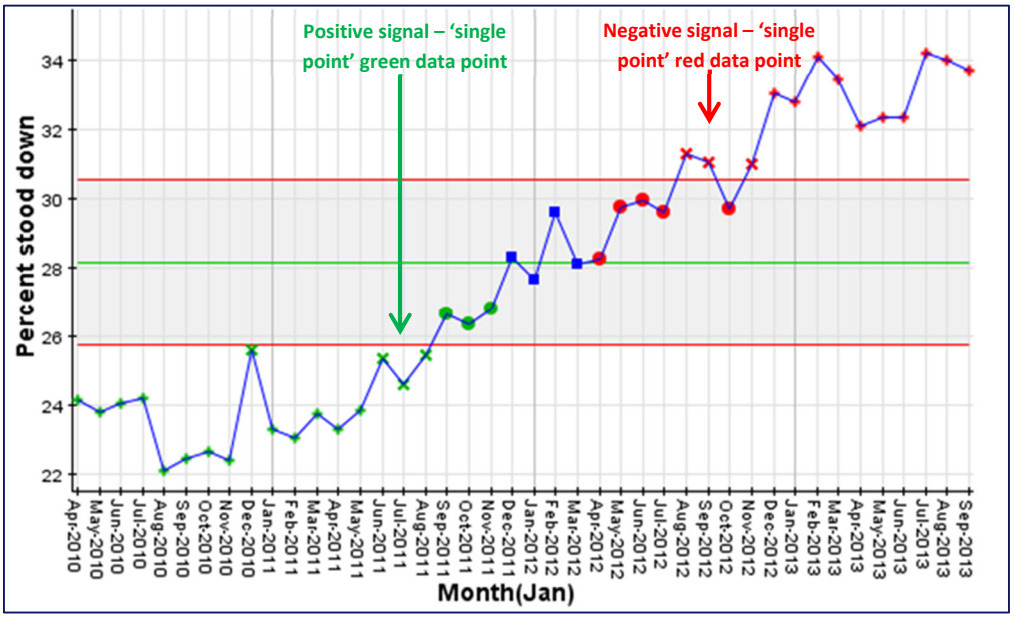
Figure 12-1: sChart showing 'run of 8' signals



The upper and lower performance guidelines are built on a degree of statistical probability (3 standard deviations away from the average). There is 99.7% probability that data points will fall within the

performance corridor, therefore if a data point should fall outside of this corridor as shown in Figure 12-2, a signal occurs.

Figure 12-2: sChart showing 'single point' signals

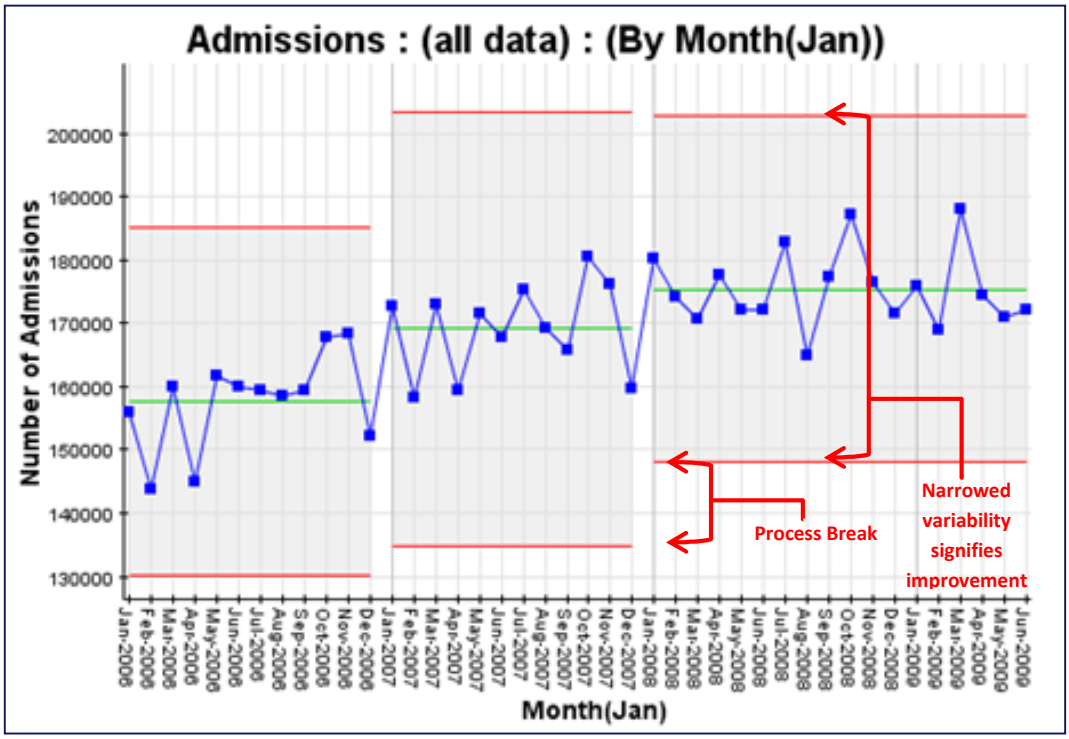


12.1.1 Process breaks

In addition to basic sCharts, ***sfn*** also supports a number of alternative representations of the data to enable investigation of underlying issues and dynamics of the data. As Figure 12-3 shows, the variability of a process can change over time. Introducing process breaks allows ***sfn*** calculate the

performance guidelines based on the current process only, preventing historical data from affecting the current value.

Figure 12-3: A basic sChart with process breaks inserted



sCharts can also show a trended pattern as in Figure 12-4 and a cyclical pattern as in Figure 12-5.

Figure 12-4: A trended sChart

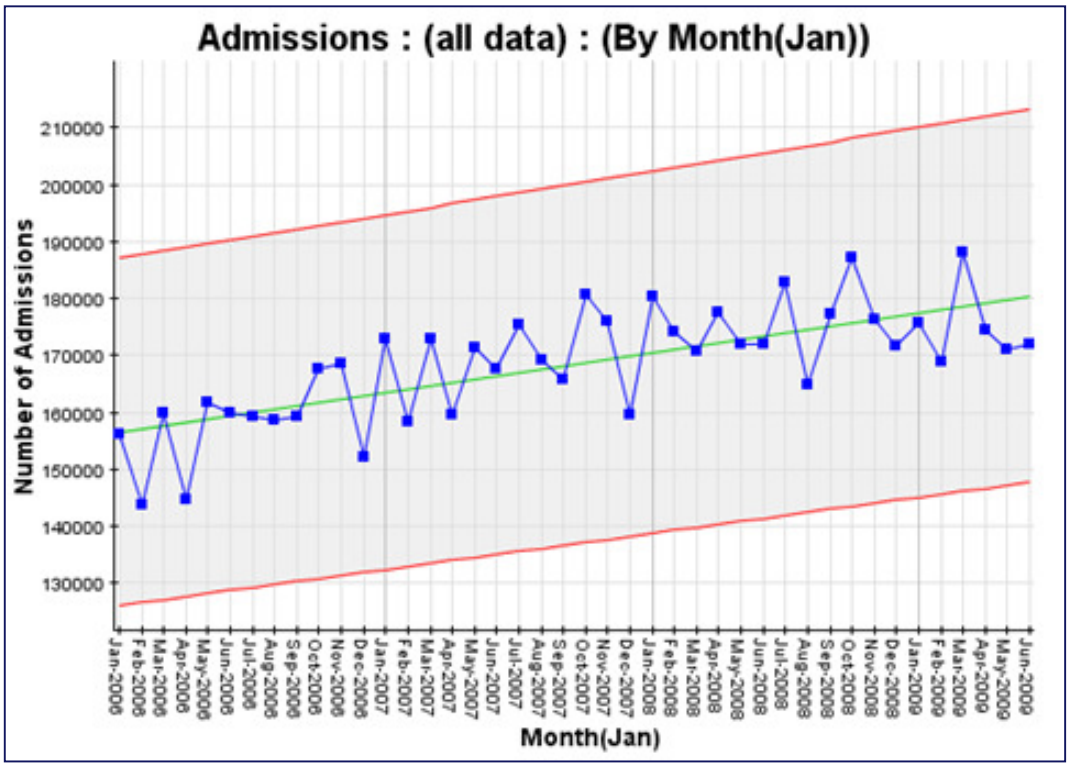
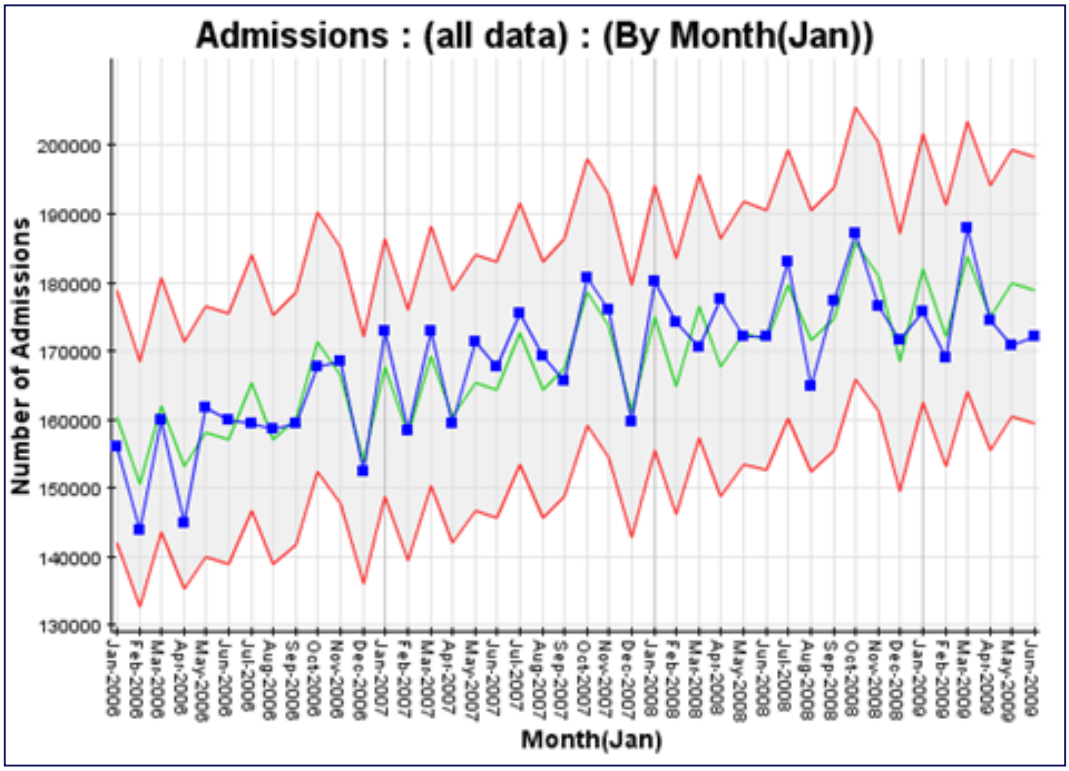
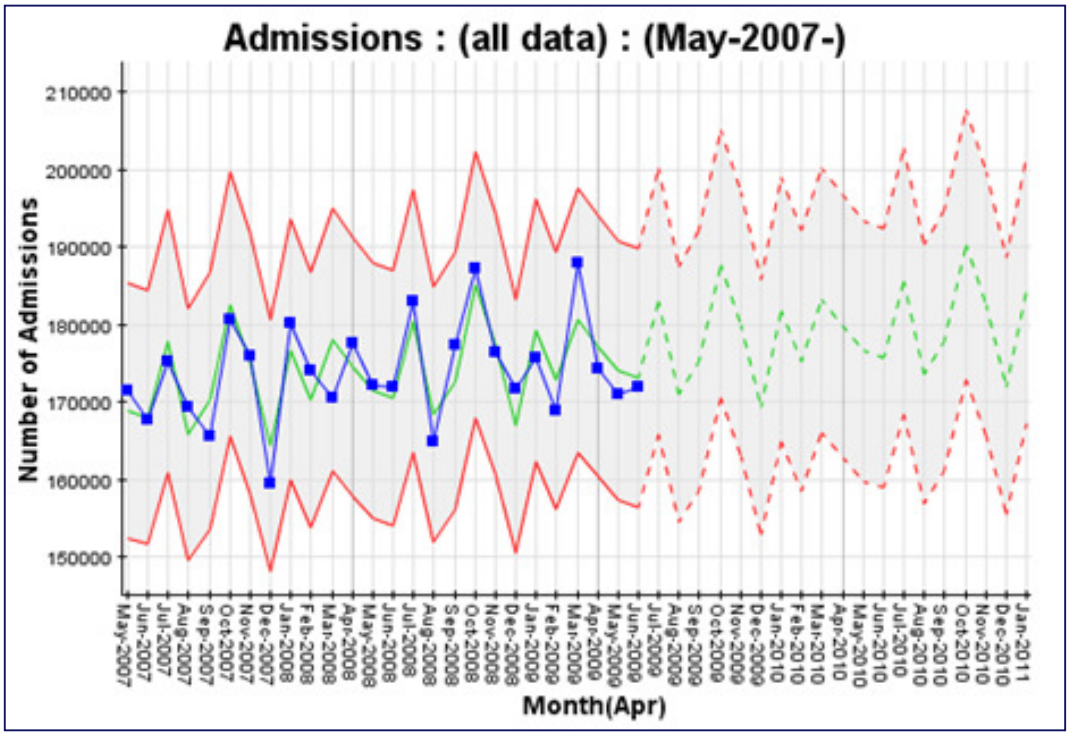


Figure 12-5: A trended sChart with a monthly cycle



Another facility (Figure 12-6) is the ability that **sfn** provides to project forward - in this case on the basis of a trended and cyclical chart type – to provide a dynamic forecast of future activity.

Figure 12-6: A trended and cyclical SPC chart with forward projection of process values

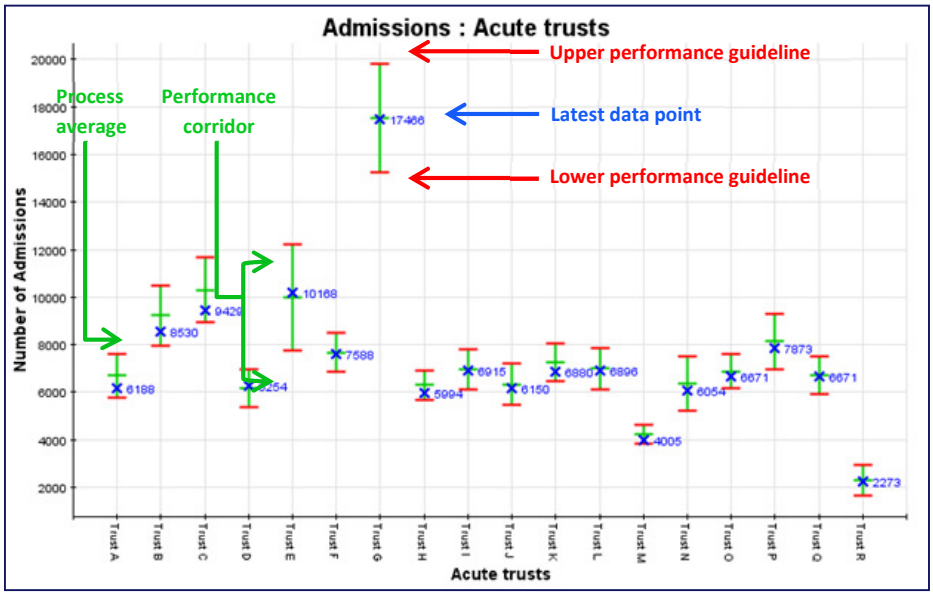


12.2 Benchmark charts

A benchmark chart can show a consolidated view of various contributors to the data shown in an sChart. These charts provide a valuable mechanism for comparing performance in terms of average

values, variability and the latest state of the process. For example in Figure 12-6 you can see that trusts E and G have the longest bars and therefore the most variability.

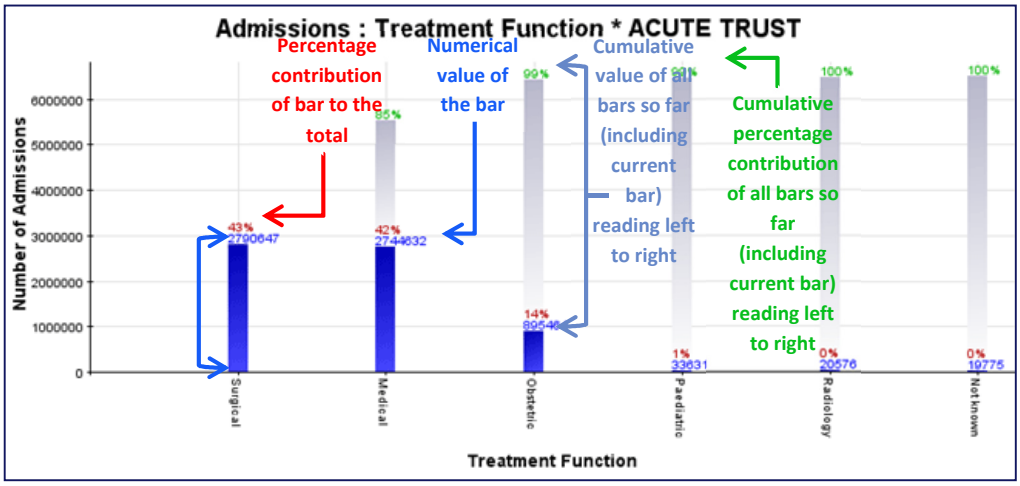
Figure 12-7: A benchmark chart showing the variability of admissions across different acute trusts



12.3 Pareto charts

Pareto charts show the contribution of different factors to the overall result shown in an underlying sChart. For example, Figure 12-8 shows the proportion of admissions to the acute trusts in the benchmark group in each of the high level Treatment Function codes. Pareto charts allow you to drill down and investigate root causes, and compare items within a hierarchy.

Figure 12-8 : A benchmark chart showing the variability of admissions across different acute trusts

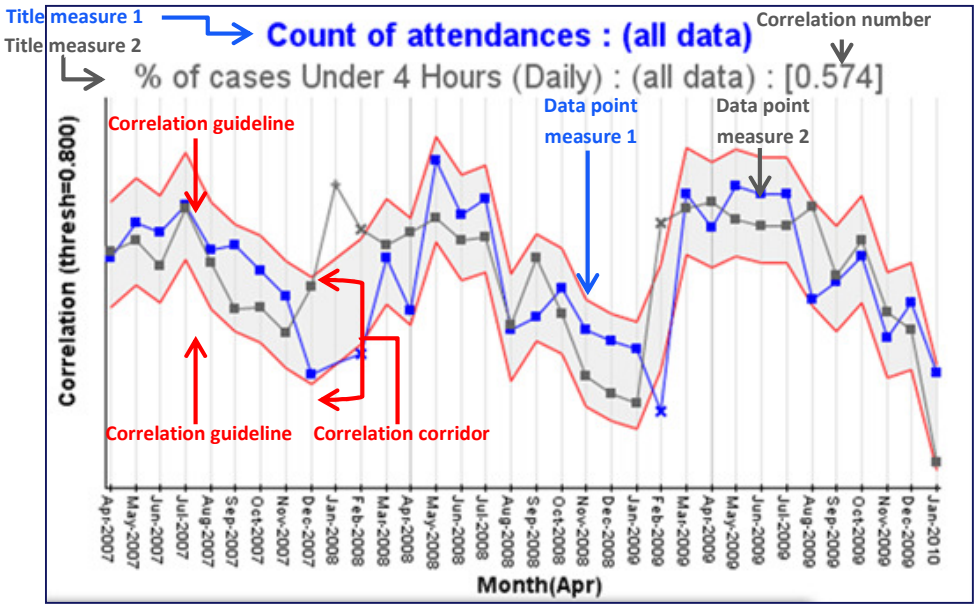


12.4 Correlation charts

Correlation charts allow the data series from two or more sCharts to be displayed together in the same chart so that **sfn** users can see how closely related the data series are. At the same time, the gap

between the correlation guidelines creates a correlation corridor that identifies regions of the data series where the correlation breaks down. The chart in Figure 12-9 has a correlation number of 0.574: correlation numbers range from -1 to 1, where -1 indicates inverse correlation, 0 shows no correlation and +1 indicates positive correlation. A strong correlation would be around ± 0.7.

Figure 12-9: Example of correlating two charts: No. of Attendances and % of cases under 4hrs



13 Appendix C – Effect of geographic category on overall performance

As we describe elsewhere in the report, we have subdivided our analysis into three separate geographic categories: major urban, minor urban and rural. It is important to understand how the split between these categories can impact performance.

Consider the simple case of an ambulance dispatching centre receiving 300 calls per hour.

If 100 calls are received from each geographic location, then for each location the expected number of calls attended within 8 minutes will be:

Major urban: 100 * 85% = 85

Minor urban: 100 * 75% = 75

Rural: 100 * 40% = 40

Therefore, the total number of calls attended within 8 minutes would be 85 + 75 + 40 = 200, which is a performance level of 66.6%.

However, at a different dispatching centre the calls aren't split evenly between different geographic locations and so the performance level changes. For example, take the case where 180 calls come from major urban areas, 100 come from minor urban areas and only 20 from rural areas. Now the performance calculation becomes:

Major urban: 180 * 85% = 153

Minor urban: 100 * 75% = 75

Rural: 20 * 40% = 8

In this case, the total number of calls attended within 8 minutes would be 153 + 75 + 8 = 236, which is a performance level of 78.6%.

The performance of the second centre appears to be higher than that of the first centre, even though both are actually offering identical attendance rates.

Note: Calculations within the report use percentage figures rather than total numbers of calls, to allow us to draw more general inferences. Therefore, in the first example above where the geographic split is even, the calculation would be:

Major urban: 33.33% * 85% = 28.33

Minor urban: 33.33% * 75% = 25

Rural: 33.33% * 40% = 13.33

As before, this gives a performance level of 66.6%.

14 Appendix D - Location of potential Community First Responder schemes

Dublin/Wicklow	North West	Midlands
Greystones	Bundoran	Clara
Charlesland	Kinlough	Portarlington
Rathdrum	Tobercurry	Mountmellick
Tinahely	Enniscrone	Moate
Rush	Newtown Cunningham	Edgeworthstown
Balbriggan	Buncrana	Abbeyleix
	Milford	

East Kildare	West	South East
Monasterevin	Westport	Cahir
Kildare	Swinford	Fethard
Prosperous	Ballaghadereen	Carrick on Suir
Celbridge	Ballyhaunis	Tramore
Kilcock	Castlereagh	Kilmuckridge
Leixlip	Tuam	Courtown
	Ballinrobe	Bunclody
	Athlone	Bagenalstown
	Gort	Ballyragget
	Portumna	Tullow
	Athenry	Callan

North East	Mid West	South
Trim	Kilkee	Ballybunion
Enfield	Miltown-Malbay	Ballyheigue
Kinnegad	Newmarket on Fergus	Charleville
Athboy	Rathkeale	Castleisland
Bettystown	Abbyfeale	Milltown
Ashbourne	Adare	Dunmanway
Kells	Killaloe	Bandon
Duleek	Borrisoleagh	Kinsale
Slane	Borrisokane	Ballincollig
Dunleer	Templemore	Cobh
Castlebellingham		Ringport
Carrickmacross		Castlemartyr
		Rathcormac

15 Appendix E – Proposed major urban deployment points initial modelling (18th February 2015)

	Existing Station	Proposed Deployment point
1	Cork Ambulance Station	Cork Ambulance Station
2	Gurranebraher Ambulance Station, Cork	Angelsea Street, Cork
3	Dublin Road, Loughlinstown, County Wicklow	Ballinclea Road, County Wicklow
4	None	Old Dublin Road Stillorgan , County Dublin
5	St James Station, Dublin	Long Lane, Dublin
6	Limerick Ambulance Station, Limerick	Garryowen Road, Limerick
7	Galway Ambulance Station, Galway	Father Griffin Road, Galway
8	Waterford Ambulance Station	Waterside, Waterford
9	Navan Ambulance Station	Kells Road, Navan
10	Sligo Ambulance Station	Sligo Ambulance Station
11	Dundalk Ambulance Station	St Anne's Court, Dublin Street, Dundalk

Proposed cover from 6.00 am until midnight Monday to Friday and until 2.00 am Saturday and Sunday.

16 Appendix F – Glossary of terms

Term or concept	Definition
AACE	Association of Ambulance Chief Executives - UK body with CEO membership from all ambulance trusts. Commissioners of this report.
Abstraction rates	The percentage of total available staff hours lost because of absence such as sickness, training, holidays etc.
Advanced Paramedic	A paramedic who has undergone additional education and training.
Alpha and Omega	Less serious calls.
AMPDS	Ambulance Medical Priority Dispatch System. System used to prioritise and dispatch appropriate aid to medical emergencies including systematized caller interrogation and pre-arrival instructions.
AP	Advanced Paramedic
Average Daily by month	Charts that show data by month have been adjusted to remove the variation caused by months of different length. This involves spreading the total monthly value across the number of days in the month.
Basic process chart	A process for which the process average is shown as a straight horizontal green line i.e. the performance corridor shows no trend or cyclicity.
Benchmark chart	A chart used to compare components by their normal range and latest data. These show as a row of vertical lines, the mid-point green line always represents the average trend, the blue x number always represents the last recorded value for the time period examined.
Best achievable performance	Performance that can be achieved with a fully rostered and fully equipped service.
Bravo and Charlie	Serious but not life threatening calls.
CAD	Computer Aided Dispatch. Technology used by ambulance control rooms to identify and dispatch nearest available resources to incidents requiring a response.
Call cycle time	The time from the clock starting to the vehicle becoming clear, whether that is on route, at scene or at hospital. The length of the cycle determines how quickly a resource becomes free to handle the next incident.
CFR	Community First Responder. A member of the community, equipped with a defibrillator and supported by the ambulance service, who can respond quickly in emergencies – CFRs can be other health providers, fire, police or trained volunteers.
Cyclic process chart	A process for which the process average follows a cyclic pattern. Because of the seasonal and weekly fluctuations in ambulance demand, many charts allow for these patterns in calculating average trends.

Term or concept	Definition
DCA	Double Crewed Ambulance. Ambulance capable of transporting patients to hospital.
Delta	Life threatening illness or injury other than cardiac or respiratory arrest.
Deployment area	A geographic area made up of a cluster of drive zones. Typically a dispatch sector within a control room.
Drive zone	A geographic area within which a crew can drive to an incident within a specified number of minutes. A tool for identifying where ambulance crews should be optimally located.
Dual Response Provision	Refers to a deployment model whereby both NAS and DFB respond to the activity in the Dublin and Wicklow dispatch area.
DFB	Dublin Fire Brigade, which takes 999 ambulance calls in Dublin.
Echo	Life threatening cardiac or respiratory arrest.
EMS	Emergency medical services.
EMT	Emergency medical technician.
Final determinant	Point at which ambulance service has identified what is wrong with the patient.
Hear and Treat	A form of ambulance response to patients that do not require an emergency response. The patient's problem is dealt with over the phone, either through the ambulance service providing clinical advice or connecting the caller with another healthcare service that can help.
HIQA	Health Information and Quality Agency – regulatory body.
HSE	Health Service Executive[15]- The HSE provides all of Ireland's public health services, in hospitals and communities across the country.
ICV	Intermediate Care Vehicle. Double crewed vehicle capable of transporting lower acuity patients.
Major urban areas	Areas of 5km radius that have 6 or more emergency calls per 24 hour period.
MDT	Mobile data terminal.
Minor urban areas	Areas of 5km radius that have 1 – 6 emergency calls per 24 hour period.
NAS	National Ambulance Service of Ireland.
NCCRP	The National Control Centre Reconfiguration Programme undertaken by NAS.
Pareto chart	A chart that shows the volume and types or areas that contribute most to signals – for example, areas with high concentrations of missed calls.

[15] http://www.hse.ie/eng/

Term or concept	Definition
Performance corridor	In sCharts, the area between the upper and lower performance guidelines– shaded in grey.
PHECC	Pre Hospital Emergency Care Council[16] The regulator for emergency medical services (EMS) in Ireland whose role is to protect the public. The PHECC is an independent statutory agency with responsibility for standards, education and training in the field of pre-hospital emergency care. PHECC also maintains a statutory register of EMS practitioners.
Process break	Some charts show 'breaks' that indicate that the calculation of the statistics has restarted. This can denote a fundamental change in the process or data under review.
RRV	Rapid Response Vehicle. Ambulance car manned by a single clinician.
Rural areas	Areas of 5km radius that have fewer than 1 call or fewer per 24 hour period.
sChart	A chart that displays activity over time, plus characteristics and highlights of change. These charts make it easy to see when something has occurred to produce a change in the process. Improvements are indicated by green lines and points, deteriorations by red.
See and Treat	A form of ambulance response to patients that can be treated at scene and do not require conveyance an acute setting. The capacity of an ambulance service to provide clinically safe 'See and Treat' services depends upon the clinical training of crews and the availability of alternative care pathways.
sfn	*signalsfromnoise*. Lightfoot's performance improvement solution. The software uses a statistical process control methodology, which enables data sets to be interrogated using statistically based evidence analysis. This enables users to quickly identify and act upon process changes within their organisation.
System status plan	Tool used by ambulance services to match deployment with demand patterns. Enhanced by Lightfoot's ***sfn*** modelling tool.
Trended and cyclic process	A process for which the process average follows both a linear trend over the whole of the process and a cyclic pattern within the process. Incident growth for ambulance trusts, for example, increases every year, but demand patterns fluctuate over the year.

[16] http://www.phecit.ie/

17 Appendix G – Deployment points and resourcing analysis

17.1 Introduction and context to Lightfoot's engagement

This report has provided a number of emerging findings and recommendations. Following an initial review by NAS, it became apparent that NAS would benefit by extending the objectives of the review to provide more detail around optimal deployment points and resourcing requirements.

One of the key emerging findings and recommendations from the initial report was that NAS should undertake a review of all vehicle deployment points in both major and minor urban areas to reduce drive times, aiming for an average drive time of 4 minutes in major urban areas.

Based on this, Lightfoot was requested to undertake a further piece of analysis with the following two objectives:

- Model the optimal deployment points and associated resource that would enable NAS to achieve the optimal performance at both 8 minutes and 19 minutes in both the major urban and minor urban locations
- Extend the analysis in the report to identify the deployment locations and the associated resource that would be required to achieve the optimal 8 minute performance level of 85% across the whole of the Dublin and Wicklow dispatch area.
- Model the implications of a dual response model provided by both NAS and DFB in the Dublin and Wicklow dispatch area (East) taking into account a 6.5% uplift for the 2015 year.

This appendix outlines the findings of this additional work. The findings are based on operational data provided from NAS Computer Aided Dispatch (CAD) systems, which has been analysed using Lightfoot's Statistical Process Control (SPC) based analytical solution **signalsfromnoise** (sfn©). This modelling used the same historical data and system configuration that was used in the capacity review and consisted of the following components[17].

- Identify optimal 8 minute deployment points (in both major urban and minor urban areas) to ensure that NAS is able to meet the objective of performing at a target level of 85% in major urban areas and 75% in minor urban areas
- Identify optimal 19 minute deployment points in relation to these major urban and minor urban areas, to maximise the opportunity to meet the 95% 19 minute target across the whole of NAS
- Review and validate the resourcing requirements for RRV and DCA resources in the Dublin and Wicklow area, as set out in Sections 5 and 6 of the main report. Establish the extent to which the refinement of the recommended deployment points for Dublin and Wicklow might alter the overall resource that would be required for NAS to meet the 85% 8 minute performance standard across the whole of the Dublin and Wicklow area

[17] The data used for this modelling exercise is based on the 2014 data from the CAD sources that were used as the basis for the main report. This data came from a number of legacy systems which employed different data conventions and which are being replaced by a new CAD for the whole of NAS.

17.2 Assumptions

This analysis is based on the following assumptions which were discussed with NAS at a workshop on 4th June 2015 and further subsequent conversations.

- Moving forward, deployment points will not necessarily be ambulance station centric
- The contribution to performance from DFB fire appliances has not been factored in as it is not part of the core DCA and RRV resource.
- 8 minute performance for major urban areas is modelled at 85% (see Table 2-5 main report)
- Geographic constraints suggest not all activity will fit into a major urban /minor urban / rural response model
- Achievable performance assumes deployment points are covered as per modelling
- The model combines the number of advanced paramedics and paramedics to provide the total number of staff required who are able to be deployed on an emergency ambulance or RRV. These numbers can be flexed in further sensitivity modelling once NAS develops its clinical model as described in Section 5.3.
- A high performing control centre which is able to see all incidents and resources immediately must be in place
- The dual response modelling with DFB and NAS - assumes DFB continue to provide 12 DCA 24/7 as a response within the Dublin and Wicklow dispatch area

17.3 Deployment point modelling

The model works by creating a number of geographical zones based upon the volume of call incidents across the country. As in the initial report, geographical zones are categorised as major urban, minor urban or rural, depending on the number of incidents that occur within a 24-hour period. (For a definition of major urban, minor urban and rural areas, see section 2.3.3 in the main report.) Note that the name used for a zone purely reflects the number of incidents that occur, and is not based on the geographical features of the zone.

Major urban areas

- These are generally larger towns that have concentrated demand
- In major urban areas, RRVs should provide the key initial response to high acuity emergency incidents

Minor urban areas

- These are generally smaller towns (and the outskirts of major towns and cities) that have moderate demand
- In minor urban areas, DCAs provide the key initial response to high acuity emergency incidents
- Supplementary RRV cover is recommended in these areas when the activity level is high (typically during daytime hours). High activity indicates that DCA cover will be insufficient to provide the necessary cover to meet the 8 minute performance standard

Rural areas

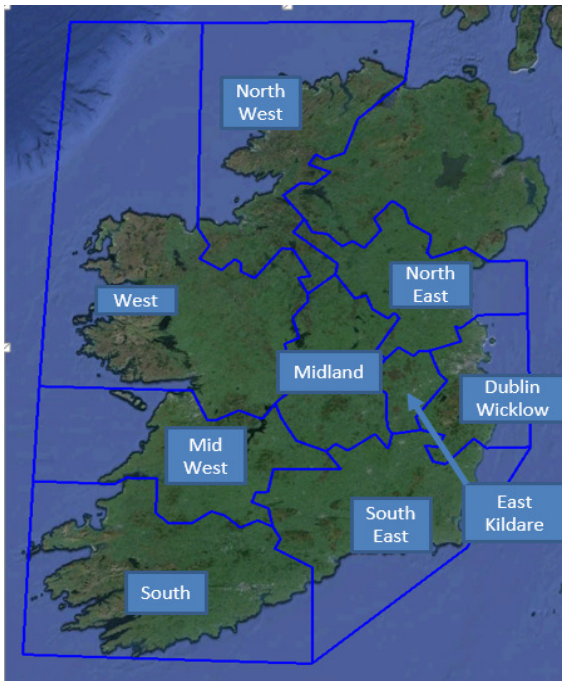
- In these areas, CFRs would be recommended as a key initial response to suitable high acuity emergency incidents
- To provide support to the initial response, a DCA or other transport resource should be available within a maximum of 30 minutes

The initial report used drive zones of 5km radius, which give a good approximation of 6 minute drive times. The distance modelling in this more detailed breakdown uses isochrones to align resources. An isochrone represents the distance that a vehicle can drive in a given time, and depends on factors such as road type.

The following key considerations were employed in undertaking this modelling exercise:

- The modelling is based on the nine current dispatch areas (former health districts) as shown in Figure 17-1 with some minor modification
- The inputs to the model are incident volume by geography (demand), by incident type and by time of day (activity)
- The model assumes that NAS will organise its dispatch and deployment process to correspond with the structure recommended in Section 7 of the report. This reflects the way in which activity cycles in and out of different hospitals
- Each dispatch area is modelled independently

Figure 17-1: NAS original dispatch areas - 2014



17.4 Drive zones to meet the 8 minute standard

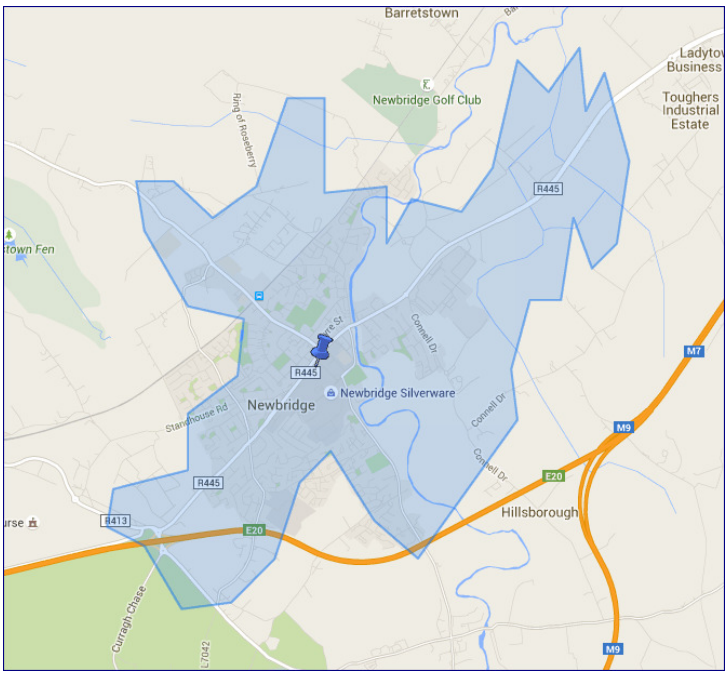
As described above, the analysis in this appendix uses 6 minute isochrones to construct drive zones (and optimal deployment points) for all of the major and minor urban areas identified in the main report.

Within each major urban and minor urban area, analysis is undertaken to determine the optimal central deployment areas from which resources should be deployed. The drive zones take into account the different road speeds and geography of the location. The travel to the patient distance is calculated conservatively using normal road speeds and ambulance resources tend to achieve better than average speeds.

Note that a 6 minute isochrone establishes a 'bounding box' around a drive zone that represents the maximum distance travelled in 6 minutes. Our experience of working with many ambulance services shows that where a service maintains adequate resource within these drive zones, it is possible to achieve an average drive to scene time of 4 minutes. Allowing for variability of drive times (caused by traffic conditions, for example, or by a vehicle not being stationed at the optimal deployment point) this is the standard required to achieve an 85% 8 minute performance requirement.

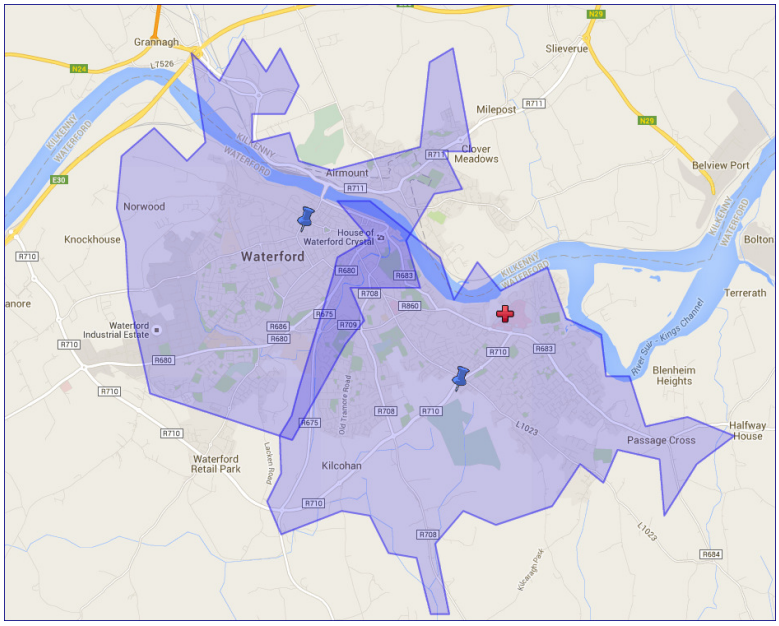
Within the smaller towns that constitute the minor urban group as well as in a number of the major urban centres, it is possible to achieve the required performance standard from a single deployment point within the town as is shown in Figure 17-2. This shows the location of the optimal deployment point as indicated by the blue pin in the map together with the area that is covered by the 8 minute drive zone.

Figure 17-2: Recommended 8 minute drive zone in Newbridge



In the larger urban centres, however, there will need to be more than one deployment point for NAS to respond from. Figure 17-3 shows the optimal deployment points within Waterford.

Figure 17-3: Recommended 8 minute drive zones in Waterford



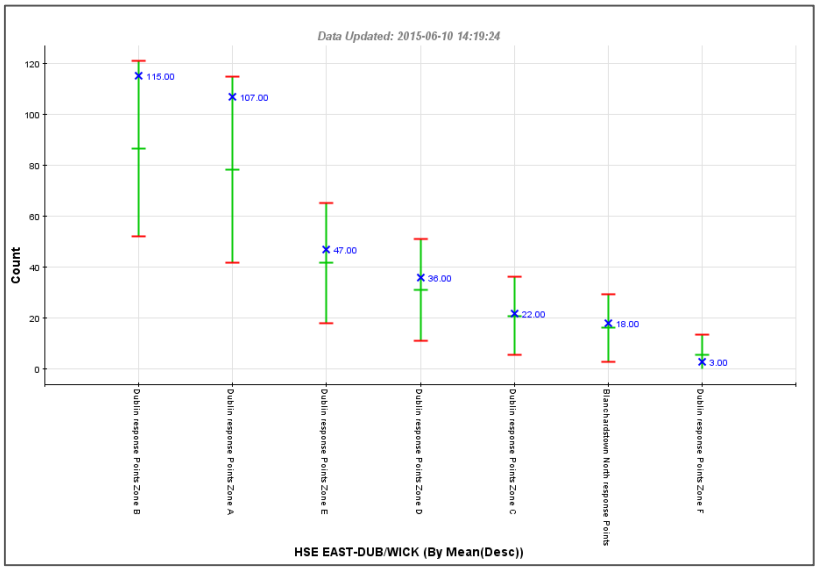
As this shows, Waterford requires two deployment points. To achieve an 85% 8 minute performance standard in Waterford, NAS would have to ensure that there was a resource available for both of these drive zones.

In the context of a large urban centre such as Dublin, the analysis of optimal deployment points is more complex - there is significant overlap between different areas and a large number of potential locations for optimal deployment points. In this context, our approach is to model the area based on the main sections of the city and then to identify the optimal number of drive zones and deployment points within each of these sections. Major urban areas (such as Dublin) often have their drive zones grouped by a combination of factors such as region or geographical distance from acute hospitals.

The 23 drive zones across the Dublin major urban area have been placed in 6 drive zone groups as shown by Figure 17-4. This benchmark chart also shows the variation in the demand across the 6

different groups. The less variation, the more predictable the demand; the higher the average demand (shown by the horizontal green line) the busier the drive zone group.

Figure 17-4: Benchmark chart showing daily emergency activity by drive zone group in Dublin



The benchmark chart in Figure 17-5 is for *Dublin Response Points Zone B* (one of the 6 drive zone groups in Dublin), and shows that the volume of daily activity varies significantly across the five different geographical drive zones within the group. Consequently, different resourcing will be required to meet the activity within each of these groups.

Figure 17-5: Benchmark chart showing daily emergency activity in drive zones in *Dublin Response Points Zone B* group

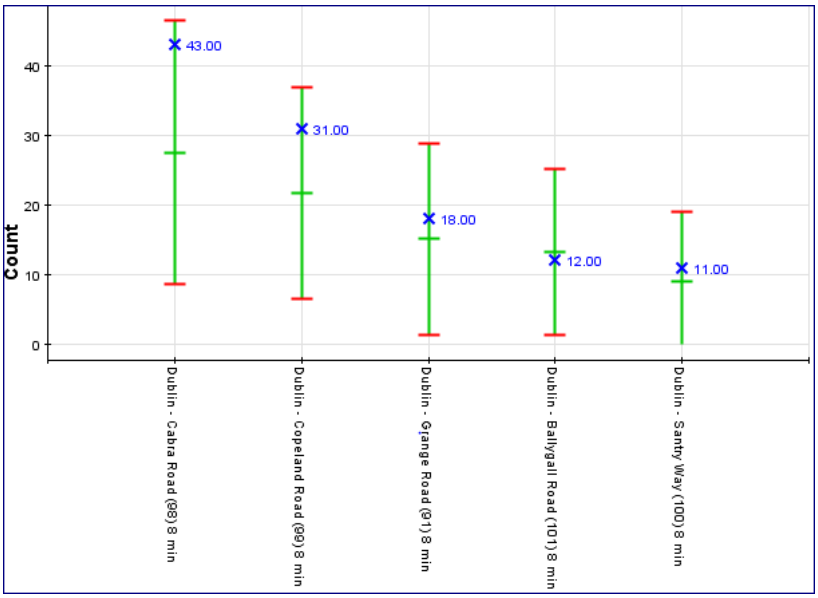
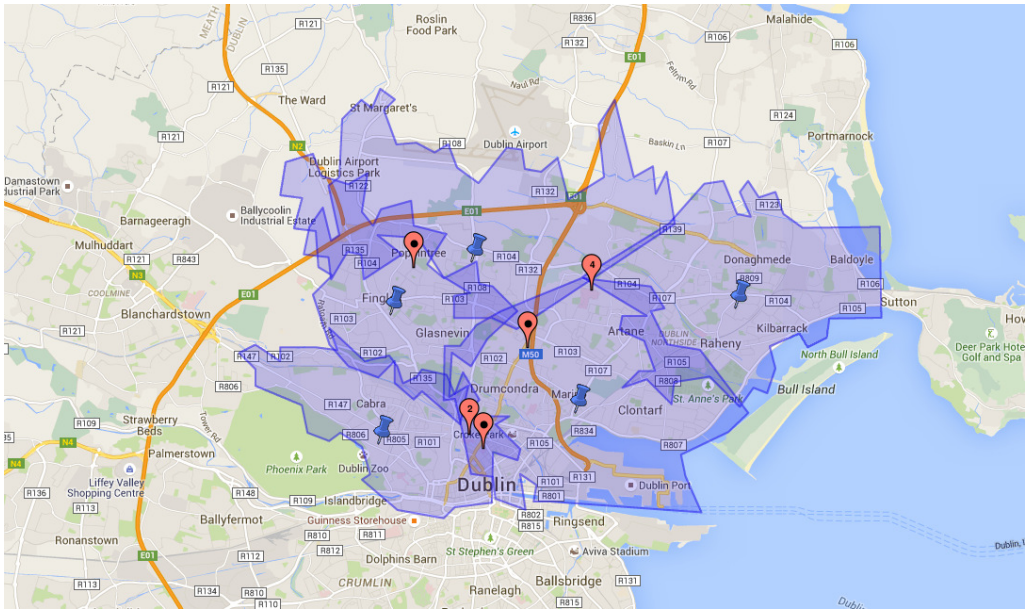
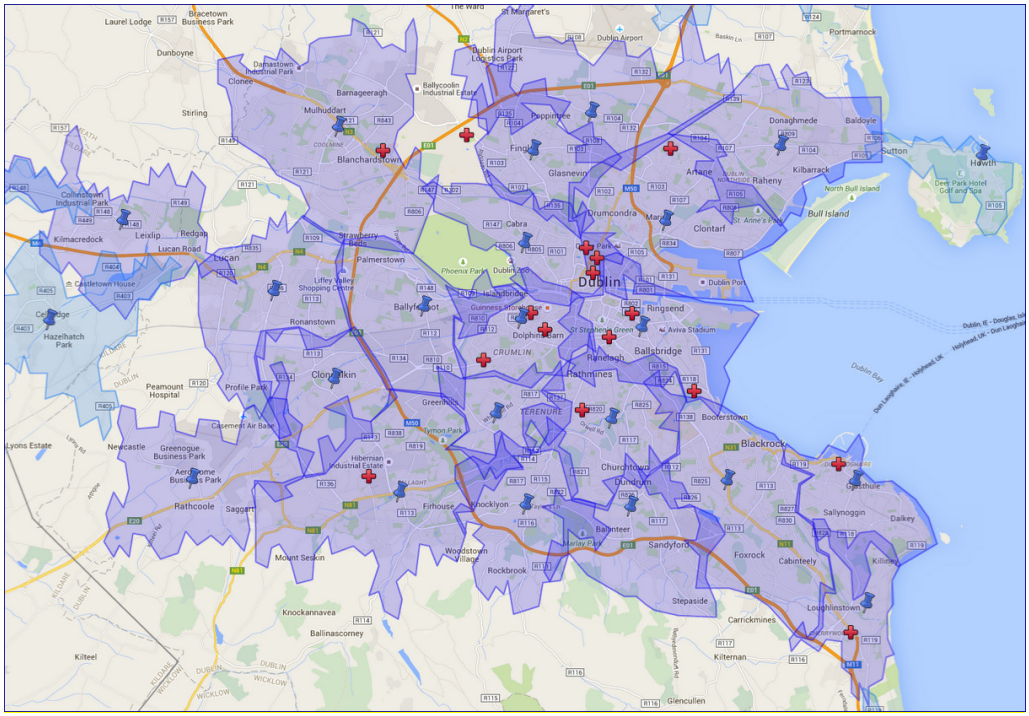


Figure 17-6: Map showing the drive zones in *Dublin Response Points Zone B* group



The overall optimal deployment approach for the Dublin major urban area therefore consists of a total of 23 different 8 minute drive zones as illustrated in Figure 17-7.

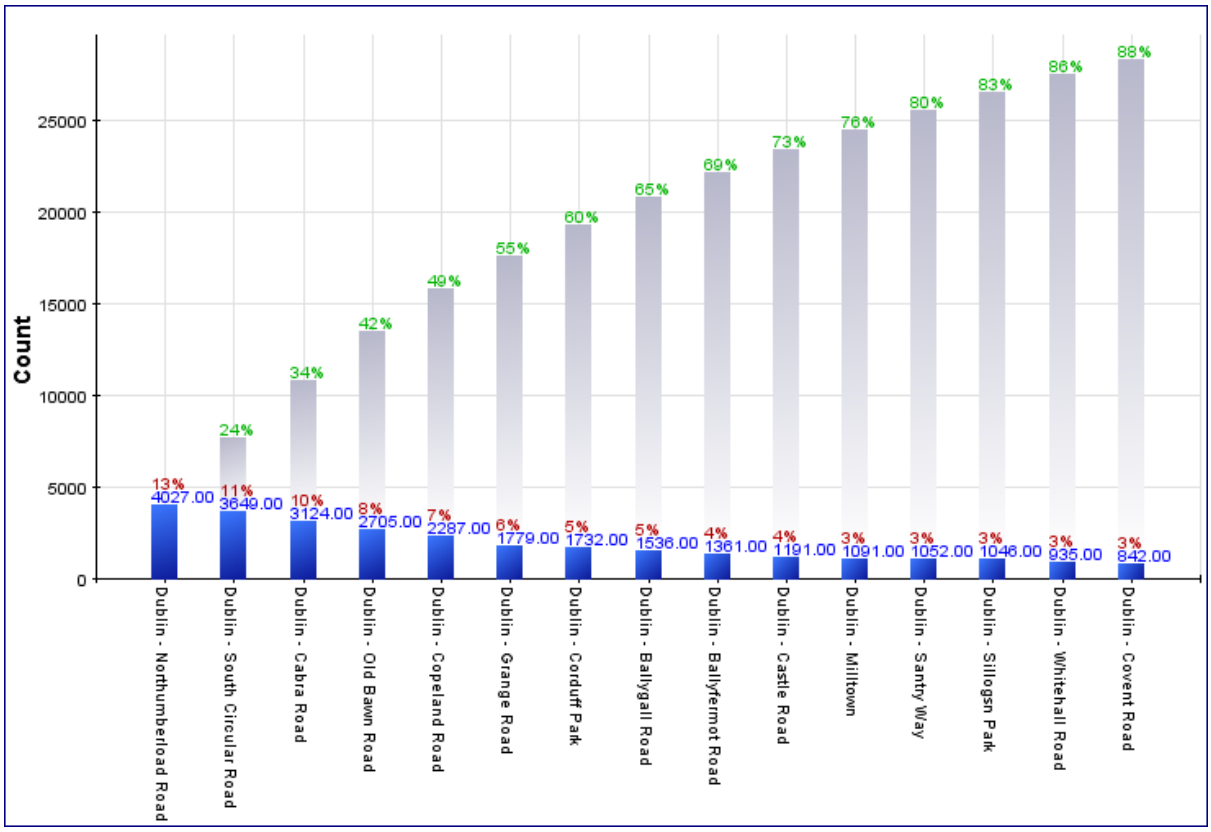
Figure 17-7: Map showing the location of recommended 8 minute drive zones in the Dublin area



As Figure 17-8 shows, the dispatch analysis shows that there are a minimum of 15 deployment points that NAS would need to resource on a continuous basis in order to meet the objective of achieving an 85% 8 minute performance standard across the whole of Dublin. The last 3 drive zones on the right in

Figure 17-8 below (Stillorgan Park, Whitehall Road & Covent Road) would be the drive zones covered 16 hours a day (08:00 to midnight) with the remaining 12 covered 24/7.

Figure 17-8: Pareto chart showing the distribution of Echo and Delta calls across the 15 most active 8 minute drive zones in Dublin



In summary, our deployment analysis has identified a total of 40 major urban and 74 minor urban 8 minute drive zones across Ireland. NAS would need to incorporate them into its deployment planning in order to achieve the levels of 8 minute performance that the main body of this report indicated are achievable by a fully resourced high-performing ambulance service. It is essential that the major urban drive zones are fully resourced and covered at all times, in order to meet the high performance target. This cover is initially provided by RRVs, with remaining incidents (where an RRV is not available to respond) resourced by DCAs.

17.5 Drive zones to meet the 8 minute standard for the new NAS dispatch areas

Table 17-1 below gives the split of the deployment zones by the new dispatch areas. There are a total of 114 drive zones for the 8 minute response.

Table 17-1: Number of 8 minute drive zones in major urban and minor urban areas by new dispatch area

	Major Urban	Minor Urban	Total
East	23	11	34
Midlands	0	11	11
Mid West	3	10	13
North East	4	8	12
North West	1	8	9
West	2	6	8
South West	5	10	15
South East	2	10	12
Total	**40**	**74**	**114**

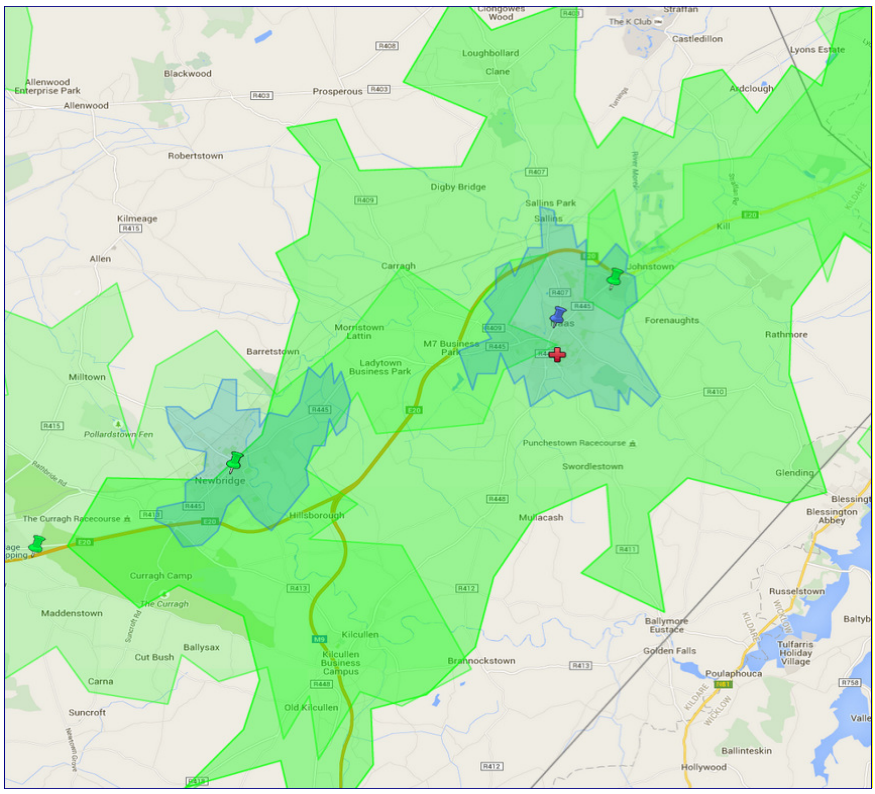
17.6 Drive zones to meet the 19 minute standard

Drive zones to meet the 19 minute standard serve a different purpose to those used to the meet the 8 minute standard. 8 minute drive zones ensure that there is always sufficient resource available and located in the right place to be able to respond to high acuity incidents. The 19 minute drive zones identify locations that maximise the likelihood that a transport resource will arrive at an incident anywhere in the country within 19 minutes. The 19 minute deployment points are therefore the optimal starting points for the double crewed ambulance (DCA).

As shown in Figure 17-9, this different set of considerations can mean that a single 19 minute drive zone can encompass more than one 8 minute drive zone. Moreover, whilst in many locations the

optimal deployment point for a 19 minute drive zone will be the same as for an 8 minute drive zone, this is not necessarily the case.

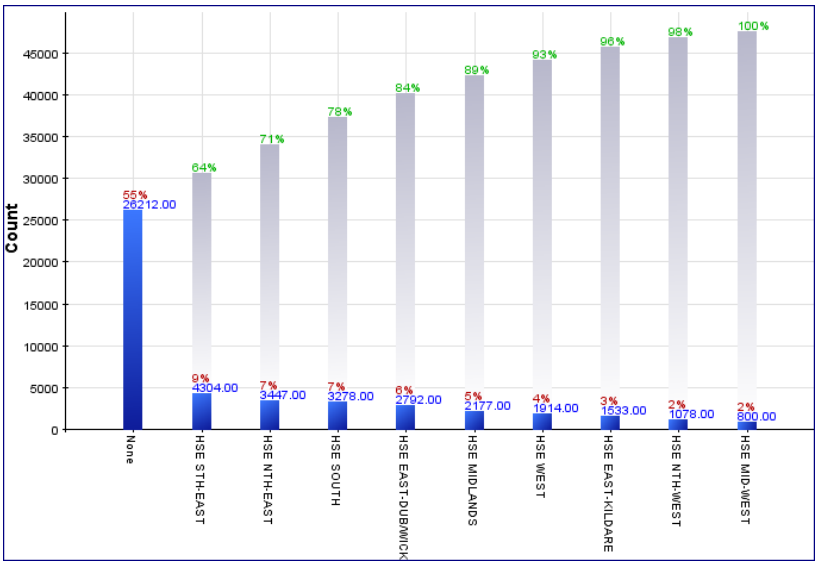
Figure 17-9: Example 19 minute and 8 minute drive zones



Since the 19 minute drive zones in major urban and minor urban areas also provide a significant component of response to rural areas, the optimal deployment points for these drive zones may need

to be closer to the rural areas. As Figure 17-10 shows, around 55% of the activity within rural areas occurs outside the areas covered by the major urban and minor urban 19 minute drive zones.

Figure 17-10: Percentage of rural activity within the scope of major urban and minor urban 19 minute drive zones by dispatch area



Consequently, NAS will need to supplement the major urban and minor urban 19 minute drive zones with a number of rural 19 minute drive zones in order to provide an adequate level of coverage within the rural area.

To meet the standard performance suggested in this report of 95% of high acuity incidents receiving a transport response within 30 minutes, our analysis indicates that NAS will require a minimum of 90 different 19 minute drive zones in the major urban, minor urban and rural areas. These are summarised in Table 17-2.

17.6.1 Drive zones to meet the 19 minute standard for the new dispatch areas

Table 17-2There are 90 drive zones for the 19 minute response. The majority of these 19 minute deployment areas are in the minor urban areas. There are 20 rural drive zones, whose locations support maximising the response to the rural activity within Ireland.

Table 17-2 below gives the split of the deployment zones by the new dispatch areas. There are 90 drive zones for the 19 minute response. The majority of these 19 minute deployment areas are in the minor urban areas. There are 20 rural drive zones, whose locations support maximising the response to the rural activity within Ireland.

Table 17-2: Number of 19 minute drive zones in major urban, minor urban and rural areas by the new dispatch area

	Major Urban	Minor Urban	Rural	Total
East	5	0	0	5
Midlands	0	11	2	13
Mid West	1	6	5	12
North East	2	7	0	9
North West	1	5	6	12
West	1	7	2	10
South West	1	14	5	20
South East	1	8	0	9
Total	**12**	**58**	**20**	**90**

18 Resource modelling by newly established dispatch areas

18.1 Resource modelling background

Section 5 in the main report estimated the number of NAS resources required for NAS to reach their best achievable performance. This was based on the data from the CAD demand and an estimated utilisation rate and excluded DFB activity which is dealt with in section 6.

The initial scope for the modelling in section 5 was not as comprehensive as the enhanced modelling in this Appendix G described below as it did not include the granular deployment point modelling and dynamic standby arrangements subsequently requested by NAS.

The section below looks at the total resource requirement for average weekly hours for vehicles and staff. It establishes the current resources being provided by vehicle type, and then compares this to the initial modelling and the more detailed deployment point modelling to provide an overall view of the resourcing requirements. The addition of the "best practice"34% relief ratio and the reduction by reallocating the current 20% overtime expenditure cost are also reviewed, and an activity uplift to take into account growth has been applied.

The modelling has been set out by the new dispatch areas that NAS have implemented since the initial modelling was undertaken.

18.2 Summary of resource hours required by the model

This section reviews the summary level numbers, by the new dispatch areas and the additional resource requirements for NAS both including and excluding DFB activity.

Table 18-1 below shows the rostered hours required to achieve the best achievable performance (as outlined in Table 5-6 of the main report). The table shows the current available average weekly rostered hours by vehicle type, as well as the initial modelling results. The final two lines show the effect of the enhanced modelling including the 6.5% activity growth.

Currently (2014 data) NAS rosters 43754 average weekly hours and DFB 2016 average weekly hours, to provide a total of 45770 average weekly hours. NAS would need to provide 59762 average weekly hours. NAS would therefore need an additional 13992 hours, this would be made up of 9258 additional DCA hours, 4334 RRV hours and 400 ICV hours in order to reach the best achievable performance standard.

Table 18-1: Additional average weekly roster hours for NAS to deliver best achievable performance– Including DFB activity

Including DFB Activity	Ambulance	RRV	ICV	Total
Current available NAS & **DFB** hours – September 2014	39932	958	4880	45770
NAS & DFB roster hours required to deliver best achievable performance (**initial modelling** see table 5-6 & Table 6-1)	46676	4536	4880	56092
NAS & DFB roster hours (**enhanced modelling**) required to deliver best achievable performance **including 6.5% activity** growth (see table 18-4 below)	49190	5292	5280	59762
Total additional average weekly rostered hours required (enhanced modelling)	**9258**	**4334**	**400**	**13992**

Table 18-2 sets out the average weekly roster hours required excluding the DFB activity.

Currently (2014 data) NAS rosters 43754 average weekly hours. NAS would need to provide **52358** average weekly hours. NAS would therefore need an additional **8604**, this would be made up of 5214 additional DCA hours, 2990 RRV hours and 400 ICV hours in order to reach the best achievable performance standard.

Table 18-2: Additional average weekly roster hours for NAS to deliver best achievable performance– Excluding DFB activity

Excluding DFB activity	Ambulance	RRV	ICV	Total
Current available NAS Hours – September 2014	37916	958	4880	43754
NAS roster hours required to deliver best achievable performance (**initial modelling** see table 5-6)	42646	3948	5280	51874
NAS roster hours (**enhanced modelling**) required to deliver best achievable performance **including 6.5% activity** growth (see table 18-4 below)	43130	3948	5280	52358
Total NAS additional average weekly rostered hours required (enhanced modelling)	**5214**	**2990**	**400**	**8604**

Table 18-3 shows the number of NAS staff required to cover the average weekly roster hours across Ireland, if the relief ratio was 34% (see section 5.1.2 main report) for Ireland, including DFB activity. To calculate the required staff in post from roster hours, we assume 28 work hours per week on average from an employee - this is consistent with a "best practice" 34% relief ratio and is a widely accepted standard. On this basis the table shows a shortfall between the number of staff in post and the number required to cover the roster at a 34% relief ratio.

In the modelling which has been undertaken the AP and Paramedic required hours and staff have been combined. This provides a view of the number of clinically trained staff required to cover RRV's and emergency ambulances, allowing NAS to flex the modelling once the best clinical model has been identified.

Currently (2014 data) NAS has around 1382 staff in post. It was determined from the modelling that NAS would need 2134 staff, an additional 752 in order to reach the best achievable performance standard.

Given that overtime expenditure within NAS currently equates to approximately 148 staff (see section 5-7), the additional number of staff that would need to be funded would be in the region of 605.

It should be noted that in a dual NAS / DFB provision model, the DFB would provide approximately 144 staff on their 12 24/7 DCA's, reducing the total additional staff required by NAS from **605** to **461.**

Table 18-3: Number of additional staff required to cover best achievable rosters for Ireland (including DFB activity)

Including DFB activity	AP / Paramedic	EMT	Total
NAS Current Staff in post (2014 data)	1233	149	1382
NAS staff required to deliver best achievable performance with 34% relief ratio including DFB activity (enhanced modelling)	1927	189	2116
No of staff required with 6.5% activity growth	**1946**	**189**	**2134**
No of staff requiring funding with new dispatch areas, (minus current overtime spend see section 5-7)	1822	165	1986
Additional staff requiring funding	589	16	605
Total additional staff in a dual provision model	**445**	**16**	**461**

Table 18-4 below shows the additional staff required excluding the DFB activity. In line with the current NAS / DFB resourcing provision, Table 18-4 provides the total number of staff NAS would require excluding the current DFB activity.

Currently (2014 data) NAS has around 1382 staff in post. It was determined from the modelling that NAS would need 1930 staff, an additional 548 in order to reach the best achievable performance standard.

However the number of **staff** requiring funding (minus current overtime spend see section 5-7) would be **1782**. Using the assumption that an additional **148** staff are already funded through NAS overtime funding, the required number of additional staff is **400** new posts.

Table 18-4: Number of additional staff required to cover best achievable rosters for Ireland – (Excluding DFB activity)

Excluding DFB activity	AP / Paramedic	EMT	Total
Current NAS Staff in post (2014 data)	1233	149	1382
No of staff required to deliver best achievable performance with new dispatch areas, 34% relief ratio and 6.5% activity growth	**1741**	**189**	**1930**
No of staff requiring funding with new dispatch areas, (minus current overtime spend see section 5-7)	1617	165	1782
Total additional staff requiring funding	**384**	**16**	**400**

18.3 New dispatch areas

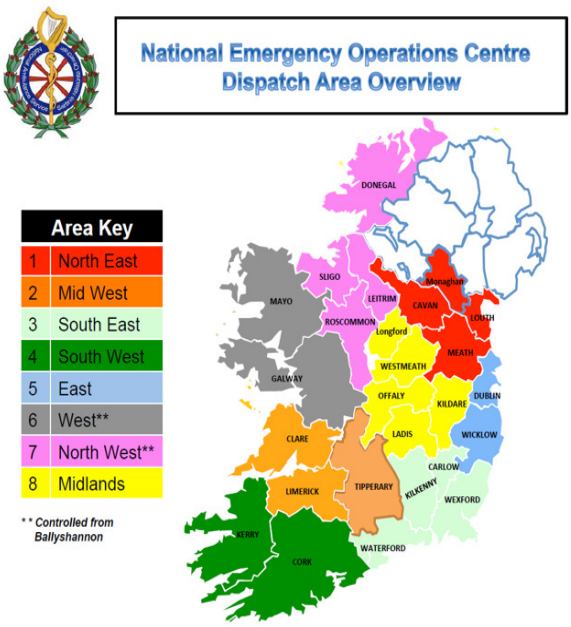
We were asked to model the resources by the new dispatch areas, as defined below.

Following the above section 17, this section reviews the resources by the new dispatch areas by vehicle hours, staff hours by skill types and vehicle numbers. NAS has made 3 changes to its dispatch areas as outlined below.

Figure 18-1: Comparison of old and new dispatch areas

The original dispatch areas (below left)

New dispatch areas (below right)

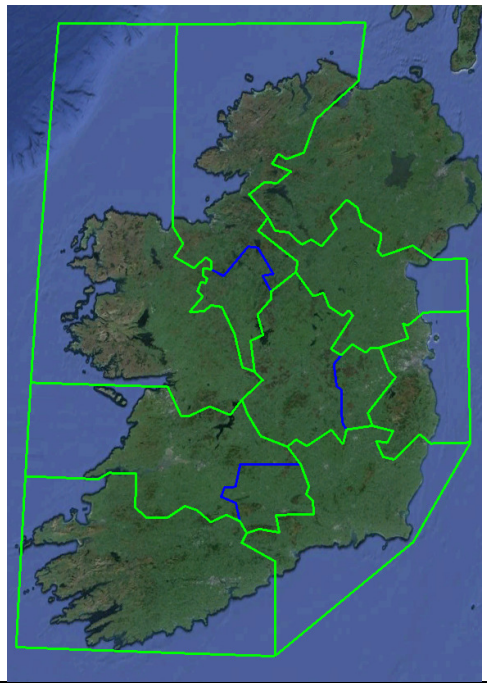


The image on the right shows the changes in the 3 dispatch areas

lightfoot

1	North East
2	Mid West
3	South East
4	South West
5	East
6	West**
7	North West**
8	Midlands

1) Kildare now within Midlands
2) Tipperary now within Mid West
3) Roscommon now within North West



The following sections provide the resourcing requirements for the new modelling and dispatch areas. There are tables setting out the "included "DFB activity and then the "excluded" DFB activity. The sections "excluding" the DFB activity provide the resourcing requirements for the current NAS / DFB provision.

18.4 Modelled vehicle hours

These tables model the average weekly vehicle hours required, these numbers include an additional 6.5% activity growth. The vehicle hours are set out by vehicle type and by the new dispatch areas.

18.4.1 Rostered vehicle hours including DFB activity

The Table below shows the total of 32264 average weekly vehicle hours of to cover all activity in Ireland through a dual provision model. These numbers include an additional 6.5% activity growth.

Table 18-5: Vehicle hours with 6.5% activity growth – including DFB activity

No. of av weekly Vehicles Hours	DCA	RRV	ICV	Total
East - Including DFB	5633	2016		7649
North East	2183	504		2687
North West	3185	588		3773
West	2355	252		2607
Midlands	2204	588		2792
Mid West	2402	336		2738
South East	2074	420		2494
South West	4296	588		4884
Sub total			**2640**	2640
Total	**24332**	**5292**	**2640**	**32264**

18.4.2 Rostered vehicle hours excluding DFB activity

The Table below shows the total of 28154 average weekly vehicle hours of to cover only the NAS activity. These numbers include an additional 6.5% activity growth.

Table 18-6: Vehicle hours with 6.5% activity growth – excluding DFB activity

No. of av weekly Rostered Hours	DCA	RRV	ICV	Total
East - Excluding DFB	2646	672		3318
North East	2219	504		2723
North West	3197	588		3785
West	2405	252		2657
Midlands	2234	588		2822
Mid West	2424	336		2760
South East	2115	420		2535
South West	4326	588		4914
Sub total			**2640**	2640
Total	**21566**	**3948**	**2640**	**28154**

18.5 Modelled rostered staff hours

These tables model the average weekly staff hours, these numbers include an additional 6.5% activity growth. They show rostered staff hours by vehicle type and assume that there would be two staff on a DCA and ICV and with only one member of staff on an RRV.

18.5.1 Rostered staff hours including DFB activity

The Table below shows the total of 59762 average weekly hours of to cover all activity in Ireland through a dual provision model. These numbers include an additional 6.5% activity growth.

Table 18-7: Rostered staff hours with 6.5% activity growth – including DFB activity

No. of av weekly Rostered Hours	DCA	RRV	ICV	Total
East - Including DFB activity	11351	2016		13367
North East	4437	504		4941
North West	6395	588		6983
West	4809	252		5061
Midlands	4468	588		5056
Mid West	4847	336		5183
South East	4231	420		4651
South West	8652	588		9240
Sub total			5280	5280
Total	**49190**	**5292**	**5280**	**59762**

18.5.2 Rostered staff hours excluding DFB activity

The Table below shows the total of 52358 average weekly hours of to cover only the NAS activity. These numbers include an additional 6.5% activity growth.

Table 18-8: Rostered staff hours with 6.5% activity growth – excluding DFB activity

No. of av weekly Rostered Hours	DCA	RRV	ICV	Total
East - Excluding DFB activity	5292	672		5964
North East	4437	504		4941
North West	6395	588		6983
West	4809	252		5061
Midlands	4468	588		5056
Mid West	4847	336		5183
South East	4231	420		4651
South West	8652	588		9240
Sub total			5280	5280
Total	**43130**	**3948**	**5280**	**52358**

18.6 Staff by skill type by new dispatch areas

The following table shows average weekly hours by skill type that would be required for NAS to deliver the best achievable performance. These numbers include the additional staff to cover 6.5% activity growth.

18.6.1 Number of staff required by skill level including DFB activity

The Table below shows the 2134 number of staff required to deliver the best achievable performance by skill type, for all activity in Ireland through a dual provision model. It should be noted that the total number of staff, NAS would require in this model would reduce depending on the number of ambulances (DCAs) provided by DFB. These numbers include an additional 6.5% activity growth.

Table 18-9: Number of staff by skill type– including DFB activity

No. of staff – including DFB activity	AP / PARA	Tech	Total
East -Including DFB	477		477
North East	176		176
North West	249		249
West	181		181
Midlands	181		181
Mid West	185		185
South East	166		166
South West	330		330
Sub total		189	189
Total	**1945**	**189**	**2134**

18.6.2 Number of staff required by skill level excluding DFB activity

The Table below shows the 1930 number of staff required to deliver the best achievable performance by skill type to cover only the NAS activity. These numbers include an additional 6.5% activity growth.

Table 18-10: Number of staff by skill type– excluding DFB activity

No. of staff – excluding DFB activity	AP / PARA	EMT	Total
East -Excluding DFB	273		273
North East	176		176
North West	249		249
West	181		181
Midlands	181		181
Mid West	185		185
South East	166		166
South West	330		330
Subtotal		189	189
Total	**1741**	**189**	**1930**

18.7 Deduction due to NAS overtime Levels

Front-line overtime levels in NAS are currently (2014 data) 20% of the pay bill (see section 5.7). If we assume that 10 % overtime is required for shift overruns and other unavoidable causes that leaves **10** % of the pay bill that could be used to fund part of the additional roster hours to deliver the best achievable performance.

As an example this provides NAS an alternative means to fund the 34% relief cover. On the assumption that overtime is paid at an average rate of 1.5 times the normal hourly rate, a 10 % overtime rate would reduce the staffing requirement by the equivalent of 148 full time equivalent staff.

18.7.1 Number of staff required by skill level with overtime deduction - including DFB activity

The Table below shows the 1986 number of funded staff required to deliver the best achievable performance by skill type, to cover all activity in Ireland through a dual provision model, having taken into account the assumption set out in 18.7. These numbers include an additional 6.5% activity growth.

Table 18-11: Number of staff after overtime deduction by skill type – including DFB activity

No. of staff – including DFB activity (with overtime budget factor)	AP / PARA	EMT	Total
East -Including DFB	452		464
North East	156		163
North West	220		231
West	159		167
Midlands	159		167
Mid West	163		168
South East	146		153
South West	291		307
Sub total		166	166
Total	**1747**	**166**	**1986**

18.7.2 Number of staff required by skill level with overtime deduction - excluding DFB activity

The Table below shows the 1782 number of staff required to deliver the best achievable performance by skill type, to cover only the NAS activity, having taken into account the into account the assumption set out in 18.7. These numbers include an additional 6.5% activity growth.

Table 18-12: Number of staff after overtime deduction by skill type – excluding DFB activity

No. of staff – excluding DFB activity (with overtime budget factor)	AP / PARA	EMT	Total
East -Excluding DFB	247		260
North East	156		163
North West	220		231
West	159		167
Midlands	159		167
Mid West	163		168
South East	146		153
South West	291		307
Sub total		166	166
Total	**1543**	**166**	**1782**

18.8 Resource vehicle numbers

This table shows the number of vehicles required to deliver the best achievable performance. This table shows peak time numbers of vehicles.

18.8.1 Number of vehicles required - including DFB activity

The Table below shows the 255 vehicles required at peak time, by vehicle type, to cover all activity in Ireland through a dual provision model.

Currently (2014 data) at peak: there are around **183** active NAS & DFB vehicles - 125 NAS DCAs, 38 NAS ICVs and 8 NAS RRVs (Table 7-1) & 12 DFB DCAs.

NAS would require **255** vehicles to deliver the best achievable performance in a dual provision model at peak, which is a total of 72 additional vehicles. These would consist of 159 DCAs which includes the 12 DFB DCAs, (additional 22 DCAs), 56 RRVs (additional 48 RRVs), and 40 ICVs (additional 2 ICVs).

Table 18-13: Number of vehicles – including DFB activity (peak time)

No. Vehicles (daily peak)	DCA	RRV	ICV	Total
East - Including DFB activity	43	17		60
North East	14	6		20
North West	20	7		27
West	15	4		19

No. Vehicles (daily peak)	DCA	RRV	ICV	Total
Midlands	15	7		22
Mid West	13	4		17
South East	14	5		19
South West	25	6		31
Sub total			40	40
Total	**159**	**56**	**40**	**255**

18.8.2 Number of vehicles required - excluding DFB activity

The Table below shows the 223 vehicles required at peak time, by vehicle type, to cover only NAS activity.

Currently (2014 data) at peak: there are around **171** active NAS vehicles - 125 NAS DCAs active, 38 NAS ICVs and 8 NAS RRVs (table 7-1).

NAS would require **223** vehicles to deliver the best achievable performance, excluding the DFB activity, which is 52 additional vehicles. These would consist of 138 DCAs (additional 13 DCAs), 45 RRVs (additional 37 RRVs), and 40 ICVs (additional 2 ICVs)

Table 18-14: Number of vehicles – excluding DFB activity (peak time)

No. Vehicles (daily peak)	DCA	RRV	ICV	Total
East - excluding DFB activity	22	6		28
North East	14	6		20
North West	20	7		27
West	15	4		19
Midlands	15	7		22
Mid West	13	4		17
South East	14	5		19
South West	25	6		31
Sub total			40	40
Total	138	45	40	223

18.9 Resource implication for the East dispatch function

It should be noted that the NAS control room modelling in Section 7 does not include the management of DFB activity and resources. The additional 210 incidents a day and associated resources that would be handled by a single control centre in a duel provision model, would significantly increase the dispatch desk work load. As outlined above this would handle around 300 incidents a day with 50 resources at peak, which would require 2 dispatch desks to cover this area. This would replace the current arrangement of separate DFB and NAS dispatch desks covering this area.

18.10 Deployment points and resource analysis conclusions

1) There are 114 separate 8 minute drive zones spread across the major urban and minor urban areas in Ireland and 90 different 19 min drive zones spread across the major urban, minor urban and rural areas. These are the key areas for NAS to focus on maintaining a response vehicle, due to the greater probability and activity of incidents.
2) The modelling has revealed 15 key drive zones in Dublin and Wicklow dispatch area that account for 90% of the incidents in the Dublin city area. The model determines that at peak time, 16 RRVs are required to reach the 85% performance in this area.
3) **Activity including DFB**: - The modelling shows that NAS would need **13992** additional average weekly hours above the current level. This would be made up of 9258 additional DCA hours, 4334 RRV hours and 400 ICV in order to reach the best achievable performance standard.
4) **Activity excluding DFB**: - The modelling shows that NAS would need **8604** additional average weekly hours above the current level. This would be made up of 5214 DCA additional hours and 2990 RRV additional hours and 400 ICV in order to reach the best achievable performance standard.
5) **Staff including the DFB activity**: - NAS would need 2134 staff – some **752** additional staff in order to deliver this standard across Ireland, however there is an assumption that due to additional 148 staff that have been already been budgeted for within NAS current (2014) funding, but the posts are not yet filled. These posts are being filled by overtime, therefore the required additional funded staff is around new posts. In a dual provision model we would assume DFB would provide 144 of these new posts, therefore bring down the addition funded staff to **461** new posts.
6) **Staff excluding the DFB activity**: -NAS would need 1930 staff – some **548** additional staff in order to deliver this standard across for the NAS activity, however there is an assumption that due to additional 148 staff that have been already been budgeted for within NAS current (2014) funding, but the posts are not yet filled. These posts being filled by overtime, therefore the required additional funded staff is around **400** new posts.
7) **Vehicles including the DFB activity**: - Currently (2014 data) there are around **183** active NAS & DFB vehicles - 125 NAS DCAs, 12 DFB DCAs, 38 NAS ICVs and 8 NAS RRVs (table 7-1). NAS would require **255** vehicles at peak time, to deliver the best achievable performance, which is 72 additional vehicles. These would consist of 159 DCAs (additional 22 DCAs), 56 RRVs (additional 48 RRVs), 40 ICVs (additional 2 ICVs)
8) **Vehicles excluding the DFB activity**: - Currently (2014 data) there are around **171** active NAS vehicles - 125 NAS DCAs, 38 NAS ICVs and 8 NAS RRVs (table 7-1). NAS would require **223** vehicles at peak time, to deliver the best achievable performance, which is 52 additional vehicles. These would consist of 138 DCAs (additional 13 DCAs), 45 RRVs (additional 37 RRVs), 40 ICVs (additional 2 ICVs)