Gwasanaeth Casglu a Throsglwyddo Meddygol Brys

Emergency Medical Retrieval & Transfer Service

The EMRTS Service Development Proposal 2022

Version control

Date	Version	Comment	Authors/ Reviewers
25/10/22	1.0	First Draft	DR
27/10/2022	1.1	Review/ Exec summary	DR MW DL
28/10/2022	1.2	Privacy protection/ redaction (inc. Optima report)	DR
31/10/2022	1.3	Finalisation and formatting	MW MC DR
1/11/2022	1.4	Formatting following EMRTS DAG	MC

Please note certain elements are redacted due to commercial sensitivities relating to the procurement of the aviation contract by the WAACT and to reduce the risk of identification of patients within the datasets (shown as less than >5).

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1.1 Executive Summary

The Emergency Medical Retrieval & Transfer Service for Wales (EMRTS) prides itself in developing evidence-based services using data routinely collected from missions and undertaking ongoing service analysis to meet the evolving requirements of the commissioners. Following on from the EMRTS 24/7 service expansion review and subsequent phase 1 expansion, the service has undertaken a comprehensive review of the service in line with commissioning intentions and the results are presented in this document. This forms the service development proposal, which is presented to the Emergency Ambulance Services Committee.

The document is a composite of multiple service reviews and analysis, but in line with recently published proposals, the core message is one of a continually improving service for the people of Wales.

The EMRTS operates in a unique partnership with The Wales Air Ambulance Charitable Trust (WAACT) with the mission statement;

"To provide advanced decision-making and critical care for life or limb-threatening emergencies that require transfer for time-critical treatment at an appropriate facility"

The concept of the EMRTS was first conceived in 2012, and following initial launch in 2015, has expanded across Wales and is now operating 24 hours a day, 7 days a week. Through multiple formal reviews, evaluations and service improvements it is aiming to deliver critical care to as many patients who require it both in the pre-hospital environment and in inter hospital transfers alike. With the addition of the Adult Critical Care Transfer Service (ACCTS) in 2021, this ambition is further realised, although outside the scope of this document.

The EMRTS is commissioned by the Emergency Ambulance Services Committee (EASC) and hosted by Swansea Bay University Health Board (SBUHB). The EASC provide commissioning intentions, which include those related to service expansion.

Since inception the service has undergone a number of service improvements and this document outlines the workstreams that feed into the latest proposal.

Building on referenced work, and evidence of benefit, the following key work streams were conducted by the EMRTS and shared with the WAACT to help inform the joint recommendations:

- EMRTS Short-Term strategy
- Review of data from 2010 – 2020, to ascertain activity by base and vehicle types, including the effect of introducing new sites, new shift patterns, and road response to the WAACT fleet.
- Detailed 4-year demand and capacity analysis, reflecting the current service and taking into account the impact of the pandemic (within the NHS).
- Optima modelling using 2021 full year as the baseline.
- Clinical working group review using extracted data.

The result of these workstreams follow;

- Total demand for the WAA/EMRTS service is 4,767 incidents per year.
- Current unmet need is around 1,300 incidents per year (across road and air).
- Daytime need is currently very well met across all parts of Wales but both North and South and Mid Wales show a significant pattern of unmet need outside of existing provision.
- The optimum model identified by Optima included the merger of the current Welshpool and Caernarfon bases into a single central North Wales base. This had the most beneficial effect, particularly when a road response was required due to aircraft being grounded.
- According to the modelling, different medical shifts operational from the proposed central North Wales location would bring the biggest benefits. One shift operating 8am to 8pm and another from 2pm to 2am (increasing coverage time in the region by 6 hours). This had the greatest single impact on increasing the numbers of patients seen within the existing resource envelope.
- Optimise the existing South Wales resources to meet demand.
- The optimal scenario modelled provides a service which would respond to an additional 583 incidents, across Wales per annum which meets 88% of total demand across Wales, across all localities and hours.
- Every county benefits from an increase in missions attended.

The service development proposal centres around the preferred option arising from the data from both in house and externally tested data and a joint review between EMRTS and WAACT.

Options Appraisal – Do Nothing (Current Configuration)

In the event a decision was taken to remain within the current configuration of service we would note an under-utilisation of our resources in Welshpool and Caernarfon. We would not be able to reach additional patients during the twilight period of the day in North and Mid Wales in a quicker time frame than the resources provided as part of our current service delivery across Wales.

Options Appraisal – Preferred Option

The comprehensive analysis undertaken by Optima (section 1.7) detailed several scenarios and the results of modelling that were considered and as a result, a conclusion was drawn from that data that a best performing option should be proposed.

Table 1 describes the current service configuration and the changes required to shift times/ new location to meet the best performing option.

Table 1

Current Service	Base location	Shift Time	HEMS Dark Hours Capable	Preferred Option	Base Location	Shift Time	HEMS Dark Hours Capable
	Caernarfon	0800-2000	No		Central North Wales	0800-2000	Yes
	Welshpool	0800-2000	No		Central North Wales	1400-0200	Yes
	Dafen	0700-1900	No		Dafen	0700-1900	Yes
	*Cardiff – Commenced April 22.	0700-1900	Yes		Cardiff	0700-1900	Yes
	Cardiff	1900-0700	Yes		Cardiff Night	1900-0700	Yes

To achieve the outcomes of the optimal scenario modelled an additional 583 incidents would be attended if all elements of the scenario were in place. This would include changes to shift start and finish times, location of bases and the ability to undertake Helicopter Emergency Medical Services (HEMS) dark hours operations across all areas of our service.

*At this time, the Cardiff day service has been operational for 6 months and will account for a percentage of the unmet need being met which is predicted to be circa 39% at full year effect. This still leaves an additional 61% of unmet demand that could be responded to as well as an increased utilisation for duty assets.

The provision of a mobile 24-hour critical care service for Wales is a complex undertaking, and the service has taken steps to ensure that all service developments are based on the best available evidence at the time, whether clinical, academic or otherwise. The overriding factors in decision making are that of equity, patient outcomes and clinical and skills sustainability, in line with founding principles. Since 2012, a number of significant interventions have been made, largely through the investment in staff provision across Wales, with a stepwise expansion realising significant benefits following continuous monitoring and evaluation. The service has reached a steady state in terms of any outcomes that can be achieved through recruiting additional staff, or setting up additional sites, and so this latest change which requires significant infrastructure changes, as well as potential disruption to existing staff was based on a significant body of evidence.

There was also a clear risk around the perception by stakeholders and the public of changes to existing sites, and so external data analysis was commissioned to independently assess the best course of action. When combining all evidence there is a strong suggestion that consolidating two underutilised teams into one site in North Wales, and staggering shifts to cover peak periods would be the best way to enhance the service. The addition of night-vision capability during the hours of darkness, also is strongly recommended.

At the time of writing the Cardiff day service (agreed in 2021) has been operational for 6 calendar months (from April 22), and is already showing significant impact both in terms of cases attended, but also in enhancement of the rural service through response or protection of the other three teams from urban calls in the South East of Wales. Whilst this aspect of the service will undergo routine monitoring and evaluation, it alone is only predicted to be responsible for 39% of the additional cases, and so the recommended model of a merged base is required to realise the remaining 61% of cases and effect the 16% increase in demand met. This is before taking into account the predicted activity uplifts over the coming years.

If agreed, then the changes would be subject to a formally managed programme looking at options for a phased implementation, with continuous monitoring and reporting to commissioners and the WAACT. The ongoing workstreams including procurement (Aviation and estates), staff impact, and

funding will be in part informed by any final decisions by the WAACT. Any feedback gained through the engagement process will be included in this programme.

1.2 Introduction

Following on from the EMRTS 24/7 service expansion review and subsequent phase 1 expansion, the service has undertaken a comprehensive review of the service in line with commissioning intentions and the results are presented in this document. This forms the service development proposal, which is presented to the Emergency Ambulance Services Committee.

1.3 Background

The EMRTS operates in a unique partnership with The Wales Air Ambulance Charitable Trust. The latest update on the service can be found in Appendix A EMRTS Annual Report 2021/22 . EMRTS have the following statements;

Our Mission

To provide advanced decision-making and critical care for life or limb-threatening emergencies that require transfer for time-critical treatment at an appropriate facility.

Our Vision

EMRTS Cymru has been developed to provide the following services to Wales:

- EMRTS Cymru delivers equity of access to pre-hospital critical care for the people of Wales.
- EMRTS Cymru delivers health gains through early interventions (provided outside of normal paramedic practice) and by direct transfer to specialist care centres. This aims to improve the functional outcomes of a patient and increase the number of 'unexpected survivors.'
- EMRTS Cymru delivers downstream benefits to smaller and more rural hospitals across Wales. More patients are taken directly to the most appropriate centre with fewer requirements for secondary transfers which previously would have depleted hospitals of specialist personnel (such as anaesthetists) created additional cost and pressures for the Welsh Ambulance Service and delayed time to definitive care in specialist centres.
- EMRTS Cymru delivers clinical and skills sustainability in Wales. EMRTS supports consultant and Critical Care Practitioner recruitment into Wales by offering opportunities with the Service as a part of the recruitment of appropriate NHS Wales positions. EMRTS Cymru also supports educational activities across NHS Wales.

Our Service

EMRTS offers a 24/7 medical operation across Wales. Services include:

- Pre-hospital critical care for all age groups (i.e. any intervention/decision that is carried outside standard paramedic practice).
- Undertaking time-critical, life or limb-threatening adult and paediatric transfers from peripheral centres (including Emergency Departments, Medical Assessment Units, Intensive Care Units, and Minor Injury Units) for patients requiring specialist intervention at the receiving hospital.
- In addition, the service provides an enhancement of neonatal and maternal pre-hospital critical care, both for home deliveries and deliveries in free-standing midwifery-led units (MLUs), including transferring neonatal teams to distant time-critical cases by air.
- The service provides a multitude of roles at major incident or mass-casualty events and a strategic medical advisor is available 24/7. This advisor is known as a top cover consultant.
- When the Wales Air Ambulance Charity helicopters are unable to fly due to poor weather conditions, EMRTS Cymru has access to a fleet of Rapid Response Vehicles (RRVs). They have been converted into state-of-the-art emergency response vehicles designed to enable the team to reach the scene of a medical emergency, by road, as fast as possible. These vehicles are stationed on all EMRTS bases in Wales.
- Medical equipment has been designed to be interchangeable between the Charity's helicopters and the RRVs.
- EMRTS Cymru is coordinated and tasked centrally via the Critical Care Hub (CCH) which is based at the Welsh Ambulance Service headquarters in Cwmbran, 24 hours a day.

Through recent engagement with stakeholders it has become clear that whilst the front-line response to incidents is quite visible and in the public eye, the events and process leading to the dispatch of a road or air response is often mis-understood. To this end, we have included an excerpt from an online article that describes the dispatch process. A further breakdown of the dispatch process is included in the strategic review documentation.

"A Day in The Life of a Critical Care Allocator[1]

What does a Critical Care Allocator actually do? After all, there are only four Critical Care Teams to deploy? - Greg Browning shares his experiences about the role of a Critical Care Allocator

This question is best answered as I did to one of our pilots; he sat looking over my shoulder at a screen full of 999 calls from all across Wales and said "So how do you know which calls to send us to?" My reply was "You look at the calls". Slightly shocked – he replied "What, ALL of them?" and then gave a comparison with people who know no better suggesting that there isn't really much to flying a helicopter – "It's only two sticks….".

That is exactly what we do.

Allocators work at a dedicated Critical Care Hub (CCH) based at the Welsh Ambulance Service contact centre in Cwmbran. It is operational 24/7, coinciding with the Wales Air Ambulance (WAA) / Emergency Medical Retrieval and Transfer Service (EMRTS) operation. Each CCH shift has one Allocator and one Critical Care Practitioner (an EMRTS medic who also undertakes clinical shifts in the air and on the road).

A variety of clues will point us to those where early Critical Care intervention will potentially improve the outcome. One example could be an unconscious and entrapped victim in a road traffic collision who might require blood transfusion, urgent pre-hospital anaesthesia and conveyance to a neurosurgical centre. Less obvious, perhaps less dramatic in appearance, but with the potential nevertheless to prevent life-changing and debilitating long-term affects might be someone who has taken a simple fall climbing over a fence. They are conscious and breathing, the injury is to their lower leg. Not at first glance one for Critical Care? On closer interrogation though, the injury is actually an open fracture where the patient's leg is badly deformed and their foot is pulseless. Our Critical Care Team will be able to administer antibiotics to offset the risk from the open fracture and give advanced analgesia and procedural sedation to allow the limb to be straightened and circulation restored. All of this is undertaken at the scene before the patient is even conveyed to hospital, thus greatly enhancing the prospects for a full recovery.

[1] https://www.walesairambulance.com/news/a-day-in-the-life-of-a-critical-care-allocator

Identifying the call is only the start. The dispatch process involves alerting the appropriate team with relevant information. With an air response, it is simply the grid reference, by road, it is a postcode. For an air response, although the Pilot and team will decide on a landing site once overhead, there are often precautions to take. This includes alerting the Police and others at scene that a helicopter is responding, giving safety advice to civilians on the ground (particularly if the helicopter will be first on scene), and advising other agencies of dispatch to avoid "confliction" (with other aircraft such as Search and Rescue who might be in the area). At times, it might be necessary to arrange for the team to be met at a landing site and conveyed to the scene, or we might need to arrange an emergency road closure to allow a carriageway landing.

During the mission we record timings, called over the air by the teams, arrange logistical support both at scene and at the receiving hospital as appropriate, and conference call medical teams on scene with receiving hospitals and sometimes the Top Cover Consultant to advise of, or decide upon, appropriate treatment and disposition. We might, of course, have all our aircraft at separate concurrent incidents or occasionally the same one.

For me personally, it is a privilege to work on the CCH knowing that we are part of a small team that makes a real difference to people's lives. Despite being a long-serving and very experienced Control Officer when I joined the team, I have learnt more in the 7 years of doing this role than at almost any time in the preceding 30, and that continues on a daily basis. Every day is different and new challenges arise to keep us constantly on our toes."

1.3.1 History & Service Evolution

The concept of the EMRTS was first outlined in the enhanced care service proposal, presented to stakeholders in 2012 which outlined the concept of a physician led enhanced care team, operating across Wales. This developed into a proposal to partner with the WAACT, forming the strategic outline programme (SOP) for the EMRTS, which was presented to Welsh Government in 2014 and approved to move to Full Business Justification Case (BJC) stage. Two BJC's were approved in 2014 relating to the Swansea and Welshpool developments, which went live in April 2015, 12 hours a day. At the same time, the Air Support Desk (ASD, now called the Critical Care Hub (CCH)) started in the Welsh Ambulance Services clinical contact centre, in Cwmbran.

In 2016 teams moved from Swansea Airport to a purpose-built facility in Dafen, Llanelli, with much improved road links and bespoke office and training areas, as well as accommodation and a dedicated fuel supply. Following the template set out in the SOP, and on the recommendation of the initial 1-year service evaluation published in 2016, which identified areas of unmet need in North Wales, and overnight, the Caernarfon service was introduced in 2017, under the direction of the independently chaired North Wales Air Ambulance Implementation Group. This development included the hybrid consultant staffing model between Caernarfon and Welshpool, and incorporation of the clinical fellowship schemes which were already established in North Wales.

These schemes were expanded across Wales in the following years. Concurrently, and at the direction of WAACT, a fourth aircraft was provided for the purpose of air transfers, operating out of a new base at Cardiff Heliport. In 2018, an in-depth review of the service was conducted in order to inform the next stages of expansion in line with the original aims to be a 24-hour service. This led to the approval of phase 1, which saw an overnight service operating on an all-Wales basis from Cardiff Heliport in 2020.

During the lead up to this, various twilight road-based services (14:00 -02:00) were run over winter periods to support the NHS, and also enable training of additional staff for the night service.

The EMRTS was also asked to host the Adult Critical Care Transfer Service, which is a pan-Wales road-based service to transfer critically ill patients between hospitals. This went live in August 2021 from Cardiff and from a new site in Bangor in October 2021. The latter operates on a 24-hour basis and is outside the scope of this proposal.

In 2021, the EMRTS published its 5-year service evaluation, which realised the original proposed benefits. It also conducted an in-depth strategic review to cover off short term improvements as well

as align with the longer-term WAACT strategic plans. In 2022, external modelling was commissioned with CSAM Optima, and its recommendations used to inform the current service improvement plans.

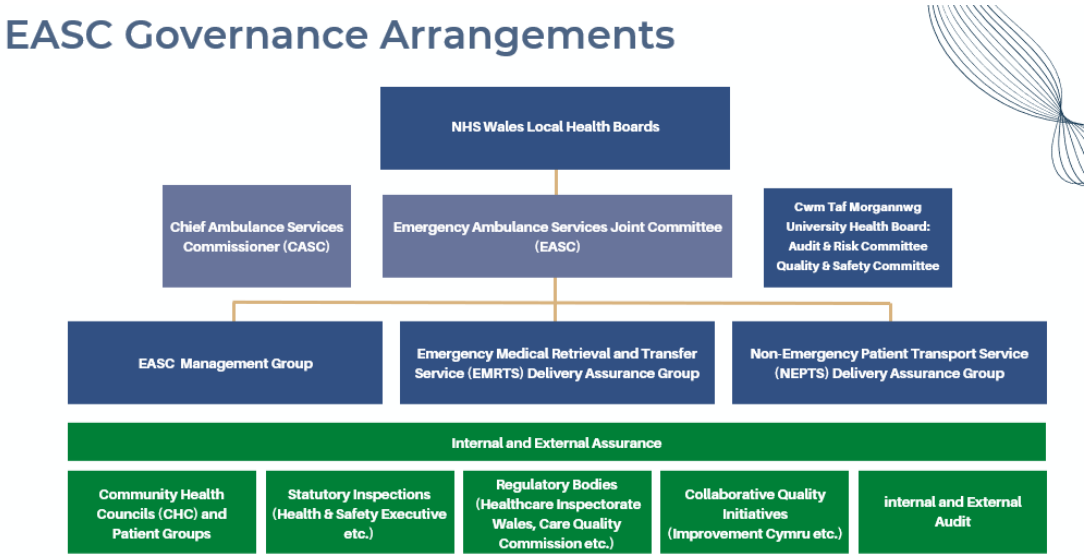
1.3.2 Governance Structures

The EMRTS & WAACT are discrete and independent entities but work in collaboration.

Their respective governance structures are depicted below. This collaboration is unique and award-winning[2], and has been proven to deliver benefits to patients and Wales alike(1,2).

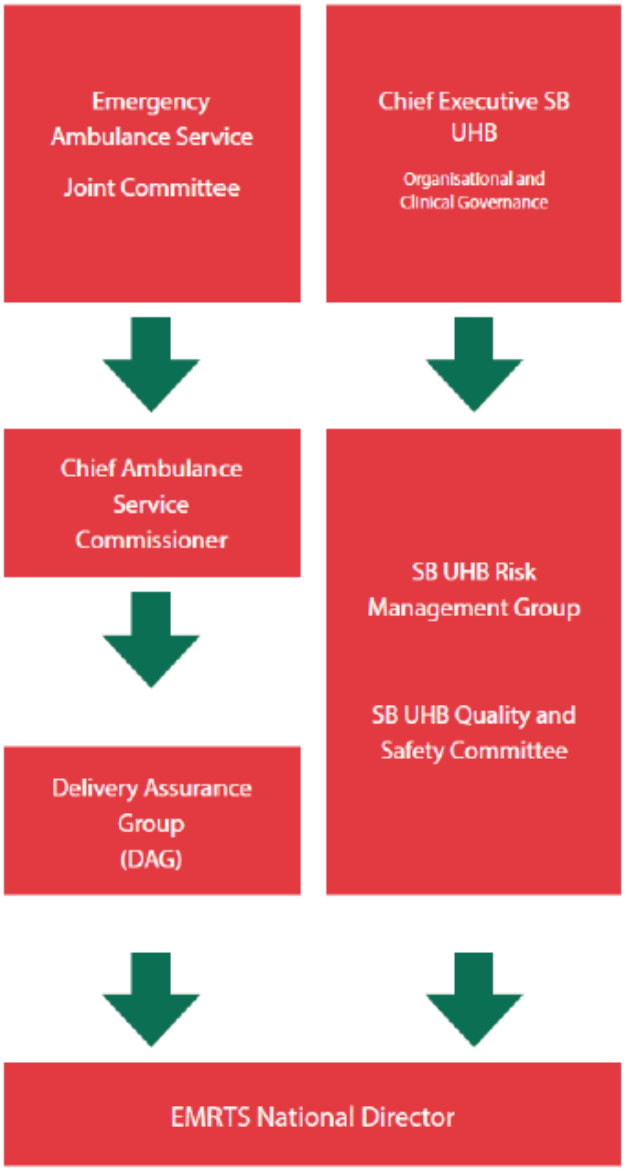
1.3.2.1 EMRTS

The EMRTS is commissioned by the Emergency Ambulance Services Committee (EASC), these arrangements are illustrated below:



[2] https://www.walesairambulance.com/news/icwaward2019

Within EMRTS and its host Swansea Bay University Health Board (SBUHB), the following structure is in place;



1.3.2.2 Wales Air Ambulance Charitable Trust (WAACT)

The WAACT is a registered Charity (1083645). Their governance arrangements are accessible online https://register-of-charities.charitycommission.gov.uk/charity-search/-/charity-details/3971343/charity-overview

1.3.3 Commissioning intentions

EMRTS Cymru is commissioned by a collaborative commissioning framework agreement against the agreed EMRTS 5-step patient care pathway. The framework focuses on outcomes, value, quality and safety of service delivery and aims to ensure reasonable expectations for the ongoing improvement of these services.

The EMRTS Commissioning Intentions set out the strategic priorities of the Committee. The Commissioning Intentions for EMRTS Cymru for 2022-23 are:

1. Service expansion
2. Adult Critical Care Transfer Service (ACCTS)
3. Service evaluation
4. System transformation

Emergency Ambulance Services Committee – Emergency Medical Retrieval and Transfer Service Commissioning Intentions 2022-23[3]

The following sets out the approach and guiding principles to the Commissioning Intentions for the Emergency Medical Retrieval and Transfer Service (EMRTS) for the period 2022-23 and beyond.

These intentions aim to reflect the strategic direction from Committee members to limit the additional asks on commissioned organisations this year including, but not limited to, minimising meetings, reporting and developments in order to allow for EMRTS to focus on consolidating following recent service expansion projects and embracing the findings of the EMRTS Service Evaluation.

These intentions are not intended to set out all activity that will be undertaken this year by commissioners or the provider, but to provide a clear indication of the priorities of the Committee for the Emergency Medical Retrieval and Transfer Service for 2022-23.

Guiding Principles for 2022-23. Intentions will:

- Be at the strategic level
- focus on outcomes, value, quality and safety of service delivery
- Support the delivery of the quadruple aims
- Have annually agreed aim(s), product(s) and indicator(s) that will provide an outline of what will be provided within each intention
- Ensure reasonable expectations for the improvement of EMRTS
- Recognise the challenges of resetting in the post-covid environment and the opportunities to fast-track service transformation and modernisation
- Ongoing engagement and review between EMRTS, commissioners and Health Boards will allow the detail of each intention to be refined during the period, if required
- Intentions will not replace or override extant requirements within the EMRTS Quality and Delivery Framework or statutory targets or requirements
- Development and monitoring
- In line with the agreed commissioning cycle, organisations have been asked for their view on the priorities for next year and consequently a principle of the incremental development of existing commissioning intentions has been adopted
- EASC Management Group will hold responsibility for the development and monitoring of progress against these intentions to ensure the strategic intent is achieved
- Regular updates will be provided to the EMRTS DAG

[3] https://easc.nhs.wales/commissioning/emrts/

- Future intentions will continue to be developed in a collaborative and timely manner in line with the agreed commissioning cycle

EMRTS Commissioning Intention – CI1: Service Expansion	
CI1a	**Enhanced CCP-led response** – Building on the findings of recent winter initiatives and demand and capacity planning undertaken within the service, support the implementation of an enhanced daytime response that will ensure more effective use of resources, improve service quality and the patient experience and provide opportunities for workforce development.
CI1b	**Planning** – Build on the implementation and consolidation of Phase 1 of the EMRTS Service Expansion project, working collaboratively with commissioners to plan the implementation of the remaining phases of the EMRTS Service Expansion programme.

EMRTS Commissioning Intention – CI2: Adult Critical Care Transfer Service (ACCTS)	
CI2a	**Service Delivery** – The ACCTS team will continue to manage ongoing service delivery and will ensure robust performance management with a focus on outcomes, value, quality and safety of service delivery.
CI2b	**Engagement** – Building on established relationships, continue to engage with all stakeholders to review and strengthen the service model(s) implemented to maximise the clinical outcomes, value, quality and safety of service delivery.
CI2c	**Evaluation and Review** – Undertake evaluation and review relating to the implementation of the ACCTS, reporting on lessons learned, service activity and providing the required assurance regarding the realisation of anticipated outcomes and benefits going forward.

EMRTS Commissioning Intention – CI3: Service Evaluation	
CI3a	**Improvement Plan** – Develop and implement an improvement plan in response to the EMRTS Service Evaluation Report.

EMRTS Commissioning Intention – CI4: System Transformation	
CI4a	**Demand and Capacity Strategy** – To continue with the work on a collaboratively developed demand and capacity strategy will set out the ongoing arrangements for proactively undertaking this work for the next decade, this will include the use of forecasting, modelling and health economic evaluations.

1.4 Strategic Drivers

As part of the review, it was identified that two additional Welsh Government drivers were relevant, published since inception of the service. These are the *6 goals for Urgent and Emergency Care, 2021 2026*[4], which has the desire to provide 'Right care, right place, first time[4]'. Also, the *Care of the critically ill: quality statement*[5], which details six quality attributes of services for people who are critically ill in Wales:

- Equitable
- Safe
- Effective
- Efficient
- Person-centred
- Timely

Both of these statements align with both the EMRTS and WAACT strategies and founding principles.

These build on the founding drivers, which also remain current, and are detailed in the original SOC and BJCs.

[4] Welsh Government Published: 4 February 2022
[5] Welsh Government Published: 7 October 2021

1.4.1 Key Milestones

The historical context is included for ease of reference in the below WAACT timeline, going back to 2001.

2001-2003

- Wales Air Ambulance launched on St. David's Day 2001.
- Bases introduced at Swansea Airport and Caernarfon Airport (x2 Bolkow 105 DB model helicopters).
- Increase from 5-day to 7-day service.

2004-2006

- Helicopters upgraded (Bolkow 105 DBS models).
- A third helicopter introduced at Welshpool Airport.
- 5,000 missions since launch.

2007-2009

- Swansea and Caernarfon-based helicopters upgraded (EC135 model).
- Air Ambulance of the Year (Health Business Awards).
- 10,000 missions since launch.

2010-2012

- Welshpool helicopter upgraded (EC135 model).
- Air Ambulance Team of the Year (ASI Awards).
- 14,500 missions since launch.

2013-2015

- Consultants and Critical Care Practitioners join WAA with pioneering medical equipment.
- Innovative Emergency Department-standard care now delivered.
- 19,000 missions since launch.

2016-2018

- New South Wales head office and airbase opened in Dafen, Llanelli.
- Fourth helicopter launched for inter-hospital patient transfers, based in Cardiff.
- Now the biggest UK air ambulance operation.
- Special Incident award winners in 2016 and 2017 (Association of Air Ambulances)
- 30,000 missions since launch.

2019-2021

- Wales Air Ambulance achieves its long-term aim of delivering a 24/7 service.
- Presented with a Social Impact Award (Institute for Collaborative Working).
- 40,000 missions since launch.

In respect of the EMRTS, the following key milestones relating to its development are listed below. Whilst not in scope of this review, we have included ACCTS for context as there is a degree of crossover in work, with both teams attending a number of time-critical transfers, freeing up the EMRTS teams for primary (999) calls or other transfers. This is subject to a future evaluation as part of the Commissioning Intentions referenced earlier.

- April 2015 - EMRTS becomes operational (Swansea Airport, Mid Wales Airport) 08:00-20:00
- 2016 – South Wales base moves from Swansea Airport to a purpose-built site in Dafen, Llanelli
- July 2017 - North Wales Expansion to Caernarfon Airport
- August 2017 - Helimed 67 introduction (initially in Dafen)
- December 2017 - Cardiff Heliport expansion
- Winter 2018, 2019, 2020 – temporary road-based twilight service (to 2am as additional team)
- July 2020 – 24-hour cover from Cardiff by road
- December 2020 – 24-hour cover from Cardiff by air
- August 2021 - ACCTS South (12-hour from Cardiff)
- October 2021 - ACCTS North (24-hour on call from Bangor)
- April 2022 - Cardiff day shift

1.5 Key reviews/ process

The service has undergone a number of formal options appraisals, reviews and evaluations as outlined in the following table. Those marked * are available online or ** by request

Year	Document	Options or outcomes	Notes
2012	Enhanced Care Service proposal*	6 road-based teams over 24/7 (Cardiff/ Newport, Swansea/ Carmarthen, Bangor + 3 other strategic sites. (12 shifts + Top cover)	Start of process
2014	Strategic Outline Programme for the EMRTS *	5 options, up to 4 bases 24/7	Introduced WAACT as a partner
2014	Full Business Justification Case for the EMRTS (x2) *	2 bases (Swansea and Welshpool), with expansion to 3rd base (Caernarfon) in future	Realised 2015
2016	FOURTH AIRCRAFT**	Wales Air Ambulance (Fourth Aircraft)	Transfer aircraft
2016	Service Evaluation year 1*	Realisation of initial benefits, and plan for further work	
2017	North Wales expansion- NWAAIG Caernarfon Briefing final **	Expand EMRTS to Caernarfon WAACT base	NWAAIG paper. Realised 2017
2017	Cardiff expansion**	Cardiff base/ Plans	
2018	EMRTS 24/7 Service review**	Long list of 20 options 7 shortlisted	Phase 1 realised 2020 (2 parts, road and air)
2019	CCIG National transfer service for critically ill adults proposal**	ACCTS proposal	Realised 2021 Additional site in Bangor, and co-location in Cardiff Heliport

2020/ 2021	EMRTS Short Term Strategy Included within this document	b. Additional staffing if required (CCP) c. 3 shortlist options (option 3 chosen) i. Do nothing ii. + Cardiff day (move Dafen Doctor) iii. **+ Cardiff day (CCP/ HTP)**	DAG & EASC June 2021 Realised April 22, option 3
2021	Service Evaluation*	Benefits realisation of EMRTS implementation and initial expansion	
2021	2021 Long term strategy Included within this document	WAA options to move Welshpool to a new site, or merge with Caernarfon in a North Central site 1. 2 final shortlist options within infrastructure constraints +/- keep same aircraft or reduce a. 4 bases, 4 aircraft, Dafen, Cardiff, Caernarfon, Broughton b. 3 bases, 3 aircraft, Dafen, Cardiff, North Central	2021 Long term strategy paper (EMRTS) Report to Trustees (WAACT)
2022	Joint review Included within this document	a. 200 scenarios tested with Optima including ability to create a new site in addition to existing bases, use existing sites, or merge sites. b. 4 bases, 3-4 aircraft c. 3 bases 3-4 aircraft d. 40 run in detail as below e. Further sensitivity analysis as a result of internal working group, around a 5th Road-based site additional to existing	Optima Reports x2 + working group document, and briefing. Summary of 40 final scenarios below, but also additional during sensitivity analysis added in (outlined in working group document)

1.5.1 Progress

Using the latest demand profiles created in 2022 (referenced later in report), a table has been compiled outlining key changes, and associated "met demand" and changes. With each service development or change there have been significant increases activity and impact on demand.

FY NHS		**Est demand met**	**Increase**	**Changes**	**Teams / Hours**
15/16*	y1	37%	0%	Service Start 2 bases (partial year)	2 / 12
16/17	y2	43%	6%	Swansea to Dafen base move, service bedding in	2/ 12
17/18	y3	49%	6%	Caernarfon expansion	3/ 12
18/19	y4	56%	7%	Twilight/ Winter pressures additional resource, Cardiff base setup	3-4 / 12-18
19/20	y5	59%	4%	Twilight by road (prep for nights). Nb, not 365 days per year.	3-4 / 12-18
20/21	y6	69%	9%	Full Nights (by road initially)	4 / 24
21/22	y7	70%	1%	Full year effect of night HEMS	4 / 24

1.6 Joint Strategic Review leading to this Service Development Proposal

Building on referenced work, and evidence of benefit, the following key work streams were conducted by the EMRTS and shared with the WAACT to help inform the recommendations:

1. EMRTS Short Term strategy
2. Review of data from 2010 – 2020, to ascertain activity by base and vehicle types, including the effect of introducing new sites, new shift patterns, and road response to the fleet.
3. Detailed 4-year demand and capacity analysis, reflecting current service and taking into account the impact of the pandemic (within the NHS)
4. Optima modelling using 2021 full year as the baseline
5. Clinical working group review using extracted data

There are also other ongoing work packages including aviation re-procurement, staff engagement and impact assessments which were considered in the final service development proposal, and will be used to inform any final decisions.

A summary of the rationale behind the review is included below, as outlined to multiple stakeholders recently.

1.6.1 Service Analysis Rationale Summary

WAA and EMRTS are currently undertaking a wide-reaching and in-depth strategic review of the Wales Air Ambulance service.

WAA and EMRTS' five-year service evaluation, published in March this year, offered strong evidence that its advanced medical provision is delivering significant benefits for patients and for NHS Wales. More patients are being attended and are surviving than ever before. You can read a summary of the service evaluation via - Seriously Injured Trauma Patients have an Increased Chance of Survival thanks to Wales Air Ambulance | Welsh Air Ambulance Charitable Trust

Knowing that it is delivering world-leading advanced critical care, now it is important for WAA and EMRTS to understand whether the service is meeting as much of its demand as possible, with the resources that it has.

At the request of the Charity, and in support of EMRTS' commission intentions, EMRTS is conducting a detailed analysis of the service's delivery data, its current demand, and its base utilisation to understand whether the service is delivering the most efficient and effective service for the people of Wales.

The review is a very important process as some elements of the service have significantly changed over the past two decades. However, as the service's medical provision and transportation have evolved, some of its base infrastructure remains the same as when it was introduced over fifteen years ago and is potentially restricting its ability to meet current demand.

Additional reasons for commencing this review are related to the Charity's ongoing aviation procurement and the global rise in the cost of goods and services.

WAA's current aviation contract is due to terminate within the next fourteen months and the procurement process offers a once-in-a-decade opportunity to review the current service provision and include this in the Request for Proposal (RFP) and the final contract with the successful bidder.

As we are all aware, the long-term impact of COVID-19 and ongoing overseas conflicts are now manifesting themselves through the increasing cost of goods and services. Organisations across the world will be subject to these increases and the Charity is no different. In particular, it is anticipating an increase in aviation costs. Therefore, it is more important than ever that WAA ensures the public donations it receives are used in the most efficient and effective way for the people of Wales, and that has been a key underlying principle of the strategic review.

However, the Charity has emphasised that this is not a cost-cutting exercise. The aim is to ensure that the service is delivering the best possible service with the resources that it has.

SERVICE ANALYSIS BACKGROUND

Last year the Charity commenced a strategic review as explained in the March 2022 edition of WAA's newsletter Helimeds – (https://www.walesairambulance.com/Handlers/Download.ashx?IDMF=723c8728-3667-4e88-96db-20c193eb21f0). It involved Trustees, the Senior Management Team and a large cross-section of staff across the Charity. Partners and other stakeholders were extensively consulted and surveyed.

The strategic review took place against the backdrop of the re-procurement of its aviation partner – with existing contractual arrangements to cease at the end of 2023 and with airbase leases aligned with that contractual term.

Within that strategic planning window, key performance data came through via the 5-year EMRTS evaluation and the opportunity to review the outcomes of twelve months of 24/7 operations. And, of course, some of the Charity's existing airbase configurations largely precede the advent of the current

critical care provision which does change some of the parameters in relation to response times and critical care pathways – success is now aligned to getting the right medical resource to the patient rather than getting the patient to the right medical resource.

EMRTS has also completed “phase 1” of its 24-hour service expansion, and in line with the programme aims, sought to evaluate this and consider the next steps to provide an equitable service for Wales, 24 hours a day.

The coincidence of these four strands (strategic review, aviation re-procurement, EMRTS 5-year Service Evaluation and 24-hour expansion) has afforded a rare and welcome opportunity for WAA/EMRTS to fundamentally examine its services and to shape and refine them in a way that is generally more difficult when at the start or midpoint of a contractual cycle.

STRATEGIC SHIFTS

Whilst the Charity has undoubtedly always been led by the needs of the people of Wales, the strategic review provided an opportunity to think less about inputs and activities and to redefine its mission and objectives in terms of patient outcomes.

Old Mission Statement

We are on standby every day of the year to protect human life through Helicopter Emergency Services and air ambulance transfers across Wales.

New Mission Statement

To deliver lifesaving, advanced medical care to people across Wales, whenever and wherever they need it.

Old Vision Statement

To provide a 24-hour operation so that we can help people both day and night.

New Vision Statement

To improve the lives of patients and their families by being a world leader in advanced, time-critical care.

The repositioning of the Charity's mission and vision and the work to define its objectives for the next five years led to some early decisions by Trustees to look at other ways in which the Charity could maximise benefits to patients. By agreeing to fund the Rapid Response Vehicles (RRVs) and to expand the Patient Liaison Nurse offering, the Charity has demonstrated its commitment to getting the best possible outcome for patients, whilst ensuring value for money and an evidence-based approach to all that it does.

The principles of patient outcomes, value for money and evidence-based decision-making have been the fundamental tenets of the work covered in the remainder of this briefing. These principles are also reflected in the key objectives which sit underneath the Charity's new mission and vision.

WORK TO OPTIMISE OPERATIONAL CONFIGURATION AND PHYSICAL FOOTPRINT

Patient Need

In asking EMRTS to come forward with proposals, the Charity wanted to understand, in a lot more detail, the extent to which the current service meets the needs of the people of Wales – not just at a national level but also at a local level. They were also keen to understand patterns of demand and whether the hours and shifts that the service historically has resourced against align with patient need. The Charity also wanted to know the extent to which the service optimises utilisation of its existing assets – air, road and medical expertise.

Initial work was undertaken by EMRTS. Using WAST data initially, they undertook a comprehensive exercise to drill down into both existing (i.e. attended) patient data over a period of four years, as well as looking at individual requests where there had been no WAA/EMRTS response and the reasons why a response had not been forthcoming. A broader 10-year analysis was also conducted looking at specific base activity over the longer term, and detailed road and air isochrones were generated with the assistance of Swansea University.

This data was analysed by time of day, by seasonality and by geography.

What this data showed was that there was an unmet need of approximately 1,300 incidents per annum which currently fell outside the service's response (across both road and air). Looking at recent patterns of activity, this reflects an additional demand of approximately 30% more per annum than is currently attended.

In North Wales/Mid Wales the deficit was predominantly due to two factors:

- Operations limited to daytime shift – compounded by limited night-vision capability in dark hours of a day shift.
- Limited road response as a viable alternative to air missions due to current base location.

In South Wales, where 24/7 has largely been centred, the unmet need was predominantly a result of demand – with late afternoon and evening peaks simply outstripping medical resources available.

EXISTING ASSET UTILISATION

When looking at existing asset utilisation, a different pattern emerged. Comparing assets in Caernarfon and Welshpool with those in Dafen and Cardiff showed that the Mid and North Wales bases (and as such medical teams) were heavily under-utilised, and this was exacerbated further during winter months – with their combined missions roughly equalling those undertaken by Dafen teams.

FUTURE SERVICE MODELLING

When looking at these two sets of findings, it was clear that a situation which demonstrated asset and resource under-utilisation but which also indicated significant unmet patient need was not optimal for the people of Wales. It was determined that as part of our aviation services procurement we should address this and take the opportunity to seek to reach as many patients as possible within the available resource envelope, whilst being conscious that the demands of the population of North and Mid Wales are different to those in the South and that equity of service needed to be as important as straight efficiency measures.

In discussions with NHS Wales commissioners, EMRTS was asked to take advantage of an independent modelling tool developed for and utilised by the Welsh Ambulance Services NHS Trust and by other providers internationally. This tool was developed by a company called Optima and takes patient data and road-based response parameters and creates an optimisation algorithm. Once "tuned", the programme can then run any number of scenarios to establish the impact of changes to service – e.g. resource availability, resource location, change in demand pattern, external events (e.g. road closures, adverse weather etc).

As the Optima model was originally developed to mirror a high-volume, road-based service, the first step was to work with them to re-tune the parameters to mirror the scenario of an air ambulance/RRV service which undertakes emergency medical and transfer missions. The re-tuned model was then tested on historical data to ensure it properly emulated the real-life operation of an air ambulance service.

The final stage of the data modelling exercise was then to run a number of scenarios (200 in total) which mimicked potential changes to both base locations and shift patterns. The scenarios are designed to build sequentially and look at the benefit (or disbenefit) of each change both on overall national capability as well as local impact. The findings of the modelling, and the improved patient benefit, are also shown below.

The headlines are as follows:

- Total demand for the WAA/EMRTS service is 4,767 incidents per year.
- Current unmet need is around 1,300 incidents per year (across road and air).
- Daytime need is currently very well met across all parts of Wales but both North and South and Mid Wales show a significant pattern of unmet need outside of existing provision.
- The optimum model identified by Optima included the merger of the current Welshpool and Caernarfon bases into a single central North Wales base. This had the most beneficial effect, particularly when a road response was required due to aircraft being grounded. **However, no decision has been made with regards to a base location in North Wales.**
- According to the modelling, different medical shifts operational from the proposed central North Wales location would bring the biggest benefits. One shift operating 8am to 8pm and another from 2pm to 2am (increasing coverage time in the region by 6 hours). This had the greatest single impact on increasing the numbers of patients seen within the existing resource envelope.
- Optimise the existing South Wales resources to meet demand.
- The optimal scenario modelled provides a service which would respond to **an additional 583 incidents, across Wales per annum which meets 88% of total demand across Wales, all localities and hours**.
- Every county benefits from an increase in missions attended and the average response time improves by 11 minutes (as demonstrated in Fig 1 and Fig 2).

Fig 1 - County-level information showing the percentage change in incidents attended (verses 2022/2023 baseline), according to the independent service analysis modelling.

Locality	***PC change***
Conwy	+11%
Denbighshire	+15%
Flintshire	+18%
Gwynedd	+7%
Isle of Anglesey	+1%
Wrexham	+2%
Powys	+11%
Carmarthenshire	+6%
Ceredigion	+2%
Neath Port Talbot	+15%
Pembrokeshire	+14%
Swansea	+13%
Blaenau Gwent	+23%
Bridgend	+9%
Caerphilly	+11%
Cardiff	+17%
Merthyr Tydfil	+18%
Monmouthshire	+14%
Newport	+35%
Rhondda Cynon Taf	+16%
The Vale of Glamorgan	+17%
Torfaen	+16%

Fig 2 - County-level impact on average response time over a 24-hour period (versus 2021 data), according to the independent service analysis modelling.

The negatives in the following table are improvements in minutes. As the table indicates, there are no increases in average response time for any region across Wales.

*Reflex time – allocation of a resource to arriving on scene

Locality Average reflex time (mins)*	*Change) minutes*
Denbighshire	-41
Flintshire	-36
Conwy	-32
Wrexham	-28
Isle of Anglesey	-13
Gwynedd	-14
Ceredigion	-15
Carmarthenshire	-12
Cardiff	-12
All Wales	-11
Pembrokeshire	-10
Torfaen	-13
Neath Port Talbot	-10
Swansea	-8
The Vale Of Glamorgan	-9
Bridgend	-9
Merthyr Tydfil	-10
Powys	0
Blaenau Gwent	-9
Newport	-8
Rhondda Cynon Taf	-9
Caerphilly	-7
Monmouthshire	-5

Through the many comments and questions that WAA/EMRTS have received, it is clear that there is a need to clarify as to how an air ambulance service operates and its specific role in the critical care landscape of Wales. This is an important point as to understand how the proposed reconfiguration would work, there is a need to understand how the service currently operates. WAA/EMRTS have started to address this, and questions that are being asked about the analysis, in a Frequently Asked Questions document [WAA/EMRTS Service Analysis - Frequently Asked Questions | Welsh Air Ambulance Charitable Trust (Walesairambulance.com)](Walesairambulance.com).

Briefings were delivered to a number of stakeholders between June and October 2022.

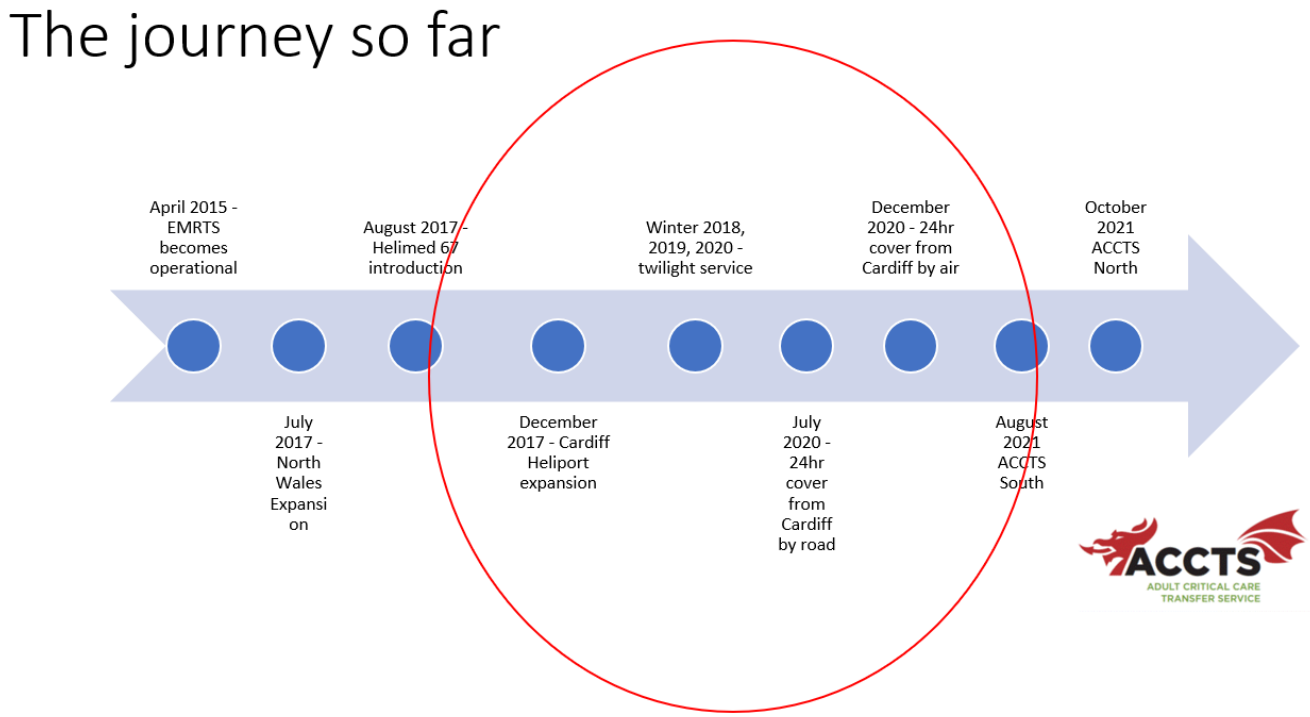
1.7 Work packages

The following precursory work packages are included in the appendix.

1. EMRTS Short Term strategy (Appendix B EMRTS Short-Term Strategy 2020-22)
2. Review of data from 2010 – 2020, to ascertain activity by base and vehicle types, including the effect of introducing new sites, new shift patterns, and road response to the fleet. (Appendix C Longitudinal review (2010 -2020))

1.7.1 4-year Demand and Capacity

Detailed records from both the 999 system, and clinical systems, as well as outcome data were reviewed in this work package. A 4-year period of utilisation was chosen as it included the North Wales expansion, but also took into account and allowed correction for the impact of the COVID 19 pandemic. During this period, the introduction of a 24-hour control room function also allowed unparalleled access to real-time data collection around the "missed tasks" which when combined with activity produce a comprehensive demand profile. This demand profile includes patient-level data and allows us to determine demand at a geo-spatial level. This supersedes the historical data included in work package 1.



A summary of the 4-year average activity is included below, by base, response mode and month. Despite the caveat of Cardiff HEMS being introduced late in this period, it reveals significantly lower activity for Mid and North Wales bases, when compared to South Wales bases.

WAA BASE	1	2	3	4	5	6	7	8	9	10	11	12	Total
WAA Caernarfon (North)	**45**	**37**	**41**	**47**	**55**	**51**	**48**	**56**	**45**	**40**	**37**	**35**	**535**
Rapid Response Vehicle	18	11	8	8	6	6	7	8	7	10	13	13	**111**
Air Ambulance	27	27	34	40	51	46	42	50	39	31	24	24	**433**
WAA Welshpool (Mid-Wales)	**44**	**40**	**53**	**52**	**58**	**54**	**66**	**62**	**57**	**47**	**44**	**40**	**616**
Rapid Response Vehicle	13	10	14	8	6	6	6	5	9	10	13	16	**110**
Air Ambulance	33	32	41	45	53	50	63	59	51	38	31	26	**521**
WAA Cardiff (South East)	**83**	**88**	**87**	**77**	**88**	**77**	**82**	**83**	**82**	**74**	**73**	**96**	**989**
Air Ambulance	15	17	19	26	27	24	25	24	22	18	16	15	**248**
Rapid Response Vehicle	69	72	69	53	63	55	58	61	61	58	58	81	**757**
WAA Dafen (South)	**107**	**94**	**100**	**90**	**108**	**98**	**113**	**110**	**104**	**100**	**100**	**99**	**1,221**
Rapid Response Vehicle	65	49	43	19	23	25	29	34	30	37	47	60	**459**
Air Ambulance	44	46	61	73	88	76	87	81	77	68	56	42	**798**
Total	**261**	**244**	**265**	**246**	**283**	**262**	**285**	**286**	**269**	**242**	**237**	**251**	**3,128**

This activity can also be summarised as an average number of incidents per day, and season as below;

WAA BASE	Autumn	Spring	Summer	Winter
WAA Caernarfon (North)	1.3	1.6	1.7	1.3
WAA Cardiff (South East)	2.5	2.8	2.7	3.0
WAA Dafen (South)	3.4	3.3	3.6	3.3
WAA Welshpool (Mid-Wales)	1.6	1.8	2.0	1.4

Ave utilization by medical team

*

WAA BASE	Autumn	Spring	Summer	Winter
WAA Caernarfon (North)				
Air Ambulance	1.0	1.4	1.5	0.9
Rapid Response Vehicle	0.3	0.2	0.2	0.5
WAA Cardiff (South East)				
Air Ambulance	0.6	0.8	0.8	0.5
Rapid Response Vehicle	2.0	2.1	1.9	2.5
WAA Dafen (South)				
Air Ambulance	2.2	2.5	2.7	1.5
Rapid Response Vehicle	1.3	0.9	1.0	1.9
WAA Welshpool (Mid-Wales)				
Air Ambulance	1.3	1.5	1.9	1.0
Rapid Response Vehicle	0.3	0.3	0.2	0.4

Ave utilization by response mode

**** NB – average utilization at Cardiff (aircraft) affected by ring fencing of HM67 for transfers***

Despite the lower volume of these sites, it is recognised that the transit times to scene, as well as to hospital, including by air or road may be longer, and so a utilisation figure was calculated. This incorporates the time crews are involved in a patient's journey, from allocation through to clearing from the incident (at scene or at hospital). This reveals a similar pattern, but importantly a significant seasonal variation.

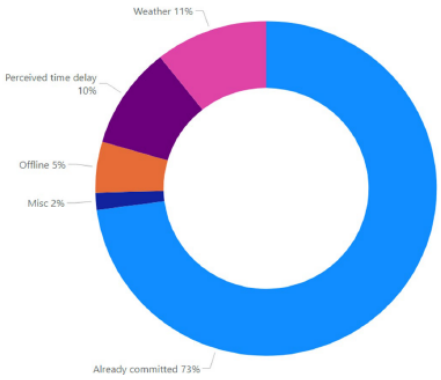
Base	Day Shift	Night Shift	Autumn	Spring	Summer	Winter
WAA Cardiff (South East)	-	37%	41%	35%	41%	32%
WAA Dafen (South)	54%	-	56%	55%	56%	50%
WAA Welshpool (Mid-Wales)	27%	-	27%	33%	33%	17%
WAA Caernarfon (North)	21%	-	18%	21%	31%	16%

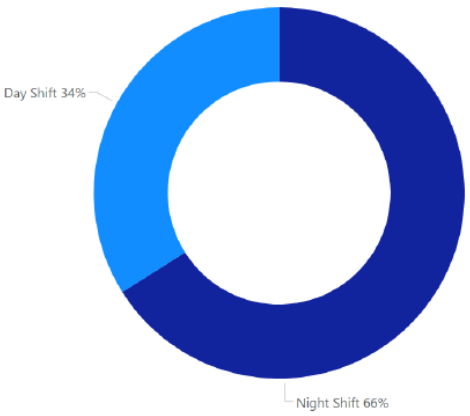
1.7.1.1 Unmet need

Since the inception of the 24-hour CCH (Critical Care Hub) in April 2020, prospective data collected is used both in day-to-day operational management, and service planning. Live 999 calls or other incidents (such as inter hospital transfers) are tagged on the 999 system, and a reason for non-attendance recorded. Options include weather, perceived time delay, offline and already committed. A summary of the unmet need (average per year) is included below;

Month

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
Day Shift	61	34	21	49	33	44	47	40	42	22	21	38	**452**
Night Shift	50	58	59	75	78	108	89	95	75	72	66	54	**879**
Total	**111**	**92**	**80**	**124**	**111**	**152**	**136**	**135**	**117**	**94**	**87**	**92**	**1331**





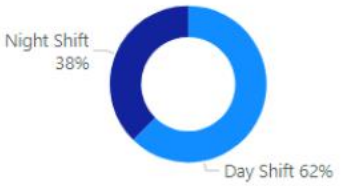
This reveals that 66% of unmet need is overnight (7pm to 7am), peaking in the summer months, and the majority (73%) are due to the crews bring already committed.

Data from the prior elements (utilisation and unmet need) were then combined into a model to give the overall demand profile. Due to the incident level information, incidents can be mapped geographically, by the time of day, by day of the year etc… and then used to conduct a detailed drill down. The all-Wales summary is illustrated below, and regional breakdowns included in Appendix E Regional Demand profile. This includes all Health Boards in Wales, and regions (North, Mid, South West and South East) as well as locality level (e.g. Ceredigion) to explore various questions during data workshops with the senior management team (EMRTS) and also representative Charity trustees.

All Wales Current Demand

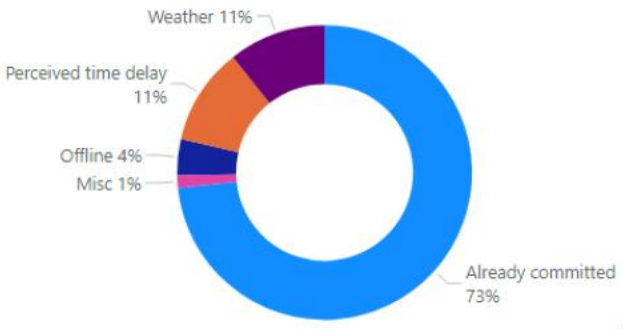
Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	11	9	7	15	17	11	14	9	10	19	9	12	143
1	8	14	7	14	11	14	9	12	14	14	6	9	132
2	4	7	4	4	8	5	4	12	9	10	11	7	85
3	6	5	6	7	10	2	10	8	1	12	6	6	79
4	4	4	7	7	9	6	3	7	4	5	4	13	73
5	8	4	5	4	2	9	4	6	10	2	5	7	66
6	6	4	7	3	6	4	8	8	6	1	11	4	68
7	14	16	13	8	13	10	13	11	10	10	9	7	134
8	17	10	10	15	22	13	19	10	17	12	13	6	164
9	21	13	12	17	15	15	19	13	21	19	15	18	198
10	13	15	19	25	17	21	17	27	29	19	21	25	248
11	29	25	24	30	24	18	26	25	35	22	22	22	302
12	16	19	29	24	37	34	30	21	37	25	25	22	319
13	20	17	20	20	18	16	24	31	13	25	23	27	254
14	21	17	19	30	22	23	24	34	32	26	15	22	285
15	25	19	22	30	21	25	22	21	27	33	28	25	298
16	22	13	24	27	25	26	24	18	29	19	24	22	273
17	23	24	20	22	20	23	24	18	27	21	15	23	260
18	12	18	16	24	21	21	22	15	26	13	14	12	214
19	15	20	16	14	23	26	24	21	18	16	17	11	221
20	21	11	16	16	22	31	34	24	15	16	20	14	240
21	13	14	11	17	14	28	29	15	17	20	25	12	215
22	7	11	19	23	15	18	14	25	22	16	15	14	199
23	14	11	12	18	22	28	14	15	17	16	13	17	197
Total	**350**	**320**	**345**	**414**	**414**	**427**	**431**	**406**	**446**	**391**	**366**	**357**	**4667**



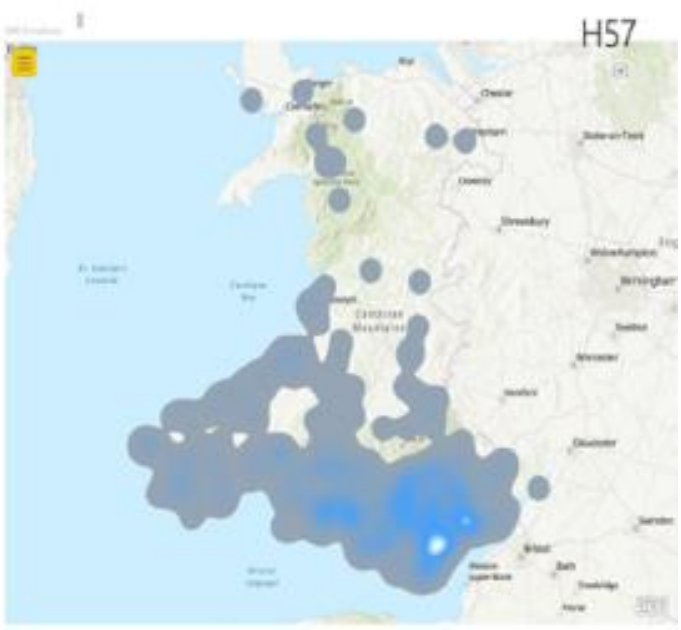
Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	233	206	228	272	255	245	264	244	303	244	224	231	2949
⊞ Night Shift	117	114	117	142	159	182	167	162	143	147	142	126	1718
Total	**350**	**320**	**345**	**414**	**414**	**427**	**431**	**406**	**446**	**391**	**366**	**357**	**4667**

Missed Task Breakdown

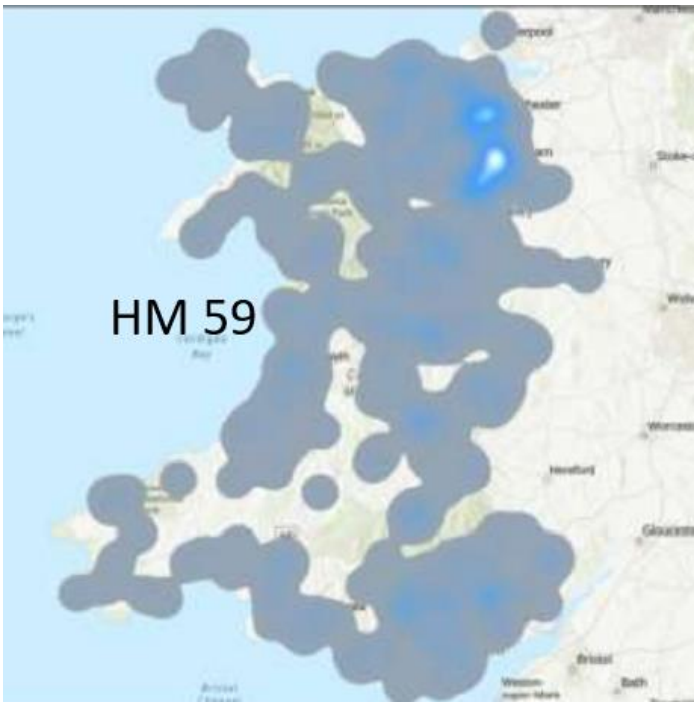


Geographical heat maps of current aircraft deployment were created as below.

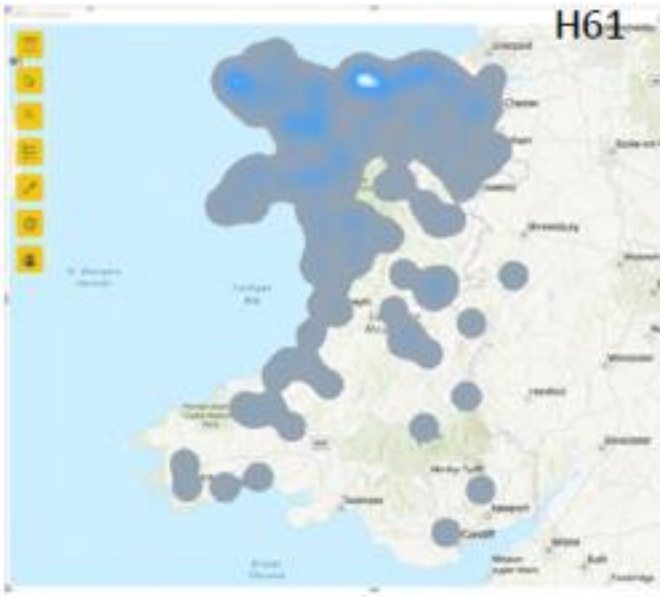
Helimed 57 – Dafen, Llanelli



Helimed 59 - Welshpool



Helimed 61 - Caernarfon



Helimed 67 - Cardiff

In addition, road population coverage data from the service expansion review was revisited, which looked at the 30, 60 and 90-minute travel times from existing sites, as well as theoretical site at Glan Clwyd hospital, and a combination of these.

Scenario	30 mins	%	60 mins	%	90 mins	%
Glan Clwyd, Cardiff, Dafen	2136070	69%	2892550	93%	3087190	99%
Caernarfon, Dafen, Cardiff	1915320	62%	2600620	84%	3059750	98%
Caernarfon	106064	3%	354833	11%	731599	24%
Glan Clwyd	326813	10%	646759	21%	733470	24%
Cardiff	1217530	39%	2023200	65%	2145440	69%
Dafen	603183	19%	2087130	67%	2353720	76%
Welshpool	51948	2%	162614	5%	869642	28%

The activity was then compared with the demand profile to create an interactive measure of performance of the service, including the ability to drill down into regions as illustrated below.

Time Period	Attended	n unmet	met %
Day Shift	2549	452	85%
Night Shift	923	879	51%
Total	**3472**	**1331**	**72%**

Hour	Attended	n unmet	met %
0	76	75	50%
1	58	80	42%
2	54	36	60%
3	44	42	51%
4	42	33	56%
5	39	30	57%
6	46	24	66%
7	107	27	80%
8	148	19	89%
9	170	36	83%
10	229	20	92%
11	264	40	87%
12	294	35	89%
13	224	33	87%
14	244	47	84%
15	262	44	86%
16	225	50	82%
17	208	58	78%
18	174	43	80%
19	152	80	66%
20	114	139	45%
21	95	127	43%
22	108	105	51%
23	95	108	47%
Total	**3472**	**1331**	**72%**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
Day Shift	**78%**	**83%**	**91%**	**84%**	**88%**	**85%**	**82%**	**85%**	**87%**	**93%**	**94%**	**85%**	**86%**
Mid	81%	80%	100%	96%	89%	85%	94%	81%	86%	100%	80%	90%	**89%**
North	77%	88%	93%	86%	92%	82%	88%	89%	84%	92%	100%	86%	**88%**
South East	78%	85%	90%	80%	87%	89%	78%	82%	89%	93%	91%	83%	**86%**
South West	78%	74%	88%	83%	83%	82%	78%	84%	85%	90%	94%	87%	**84%**
Night Shift	**63%**	**57%**	**54%**	**52%**	**54%**	**47%**	**51%**	**46%**	**52%**	**55%**	**56%**	**60%**	**54%**
Mid	33%		25%	33%	43%	50%		14%	63%	60%	33%	33%	**35%**
North	33%	18%	27%	24%	35%	22%	27%	21%	10%	19%	13%	13%	**22%**
South East	75%	74%	64%	63%	63%	55%	62%	58%	68%	68%	71%	72%	**65%**
South West	59%	44%	46%	47%	53%	48%	53%	58%	48%	50%	48%	74%	**53%**
Total	**73%**	**74%**	**78%**	**73%**	**75%**	**68%**	**70%**	**69%**	**76%**	**78%**	**79%**	**76%**	**74%**

This information was presented to multiple stakeholders, both internal and external.

1.7.2 Optima modelling

CSAM Optima were contracted to undertake discreet simulation modelling of the service. Already having access to the raw 999 data for Wales including incoming calls, and responses by all vehicles, including the EMRTS RRVs and Wales Air Ambulance Helicopters, the first task was to perform an in-depth tuning exercise to ensure the baseline model reflect reality. The key areas that needed to be addressed initially were the behaviour of clinical teams, and how they interact with road or air vehicles, the dispatch rules, and the speed of a response. The interaction between a response and a conveyance are also quite complex, and often patients travel by road, following an air (or road) response by the service, so this had to be considered. Finally, the relatively high unavailability of aircraft for a response needed to be factored in, whether through light levels, or weather conditions.

Through a series of clinically and operationally led workshops, a number of options were proposed to be tested, then discussed at length through joint WAA/ EMRTS workshops. The final options, which when combined equalled over 200 scenarios, were run through the validated Optima model.

Initial results supported the overall published conclusions, but the EMRTS identified some weakness in them, through experience, such as the impact of weather and a higher rate of road transport versus air. Through joint discussion it was agreed to run further scenarios to take these real-live issues into account. A second report (Appendix H Optima EMRTS Unmet Need Scenarios 01 – 04 (V2)) included these factors, and still came to the same conclusions.

1.7.2.1 Optima model creation

At the start of the process with Optima, a number of documents were provided that outlined the mode of operation of the EMRTS, including Operational Standard Operating Procedures relating to the operation of the Critical Care Hub, and the tasking criteria for both primary (999 calls) and secondary (inter hospital transfers). Combined with calls to discuss how a team is dispatched in practice, this enabled the team to understand how the service differs from the wider Welsh Ambulance response. Some of these complexities are explained earlier in relation to the Critical Care Hub function.

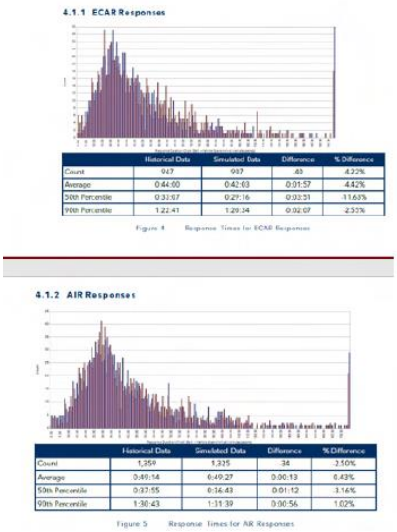
Some key areas of difference include the ability for a team to respond in different vehicles, rather than staying on one mode of transport for a whole shift. Air ambulances also behave in a different way to other ambulance vehicles, and the RRVs also operate over significantly longer distances than ambulance service vehicles. Other factors considered include the difference in time taken to travel to

hospital by road (often slower) and the consideration of case abandonment logic, taking into account the fact that calls do not continue to "wait" for an EMRTS response, in the same way they would remain active until a WAST resource arrives.

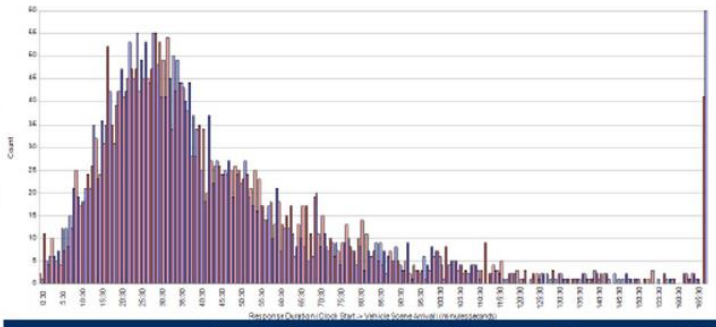
Unmet need data (unique identifiers/ raw data) was also imported into the model, helping identify candidate cases from the existing data held.

2021 was chosen as the latest representative year for the work, and the impact of COVID was considered in this decision. Whilst there was a decrease in activity in March and April 2020, overall activity for 2020 increased by 12.1%. The data used to define the baseline model with optima was the 2021 calendar year, and included a full year effect of night response, and so is reflective of the baseline and a recovery from the early pandemic period. Additionally within the Optima model, the 2022/2023 situation (i.e. at time of writing) were also simulated prior to testing the various scenarios.

The initial simulation was run, and a process of "tuning" commenced, whereby the model was compared to reality for both air and road response, as well as overall, and was shown to highly correlate in terms of responded incidents, and time as seen in the graphs below.



4.1.3 All EMRTS Calls



	Historical Data	Simulated Data	Difference	% Difference
Qpunt	2,238	2,199	-39	-1.74%
Average	0:46:28	0:46:28	0:00:00	-0.00%
50th Percentile	0:35:33	0:33:53	-0:01:40	-4.69%

1.7.2.2 Assumptions

Once tuning was complete, further information around the operation of the service was provided including the following assumptions:

- Cardiff HEMS day shift doesn't exist in baseline data (started 2022)
- 3 aircraft initially (i.e. max of 3 aircraft responding to EMRTS suitable incidents at any given time, reflecting 2021)
- 12-hour shifts, no break, available full shift
- Unmet need data included
- Assume same number of clinical teams available irrespective of transport method

1.7.2.3 Scenarios

A number of staged scenarios were developed during the data workshops, both to take into account planned developments such as the addition of a day HEMS crew to Cardiff, and further explore merged base options.

1. Add a day shift to Cardiff Heliport 07:00-19:00
2. Merging of Welshpool and Caernarfon into the following locations as a single shift (08:00-20:00)
    a. Caernarfon
    b. Welshpool
    c. North Central Conwy County
    d. North Central Denbighshire
3. Adding a "twilight" shift to 2a,b,c,d – within the hours of 8am – 02:00, 12-hour shift (we are considering 12:00-00:00, 13:00-01:00, 14:00-02:00 as options but want to find the optimum)
    a. With this additional shift, if an additional aircraft were available to the teams, what would be the optimum timing and location be
4. Additional question, following optimum placement of item 2/3 latest finish 02:00.
    a. Adding a twilight to Cardiff base,
    b. or shifting the start time to the right

1.7.2.4 Outputs

1. Number of incidents responded to
2. Change in incident numbers for all bases for each scenario (impact)
3. Utilisation % of shift
4. Incident by locality – change
5. Proportion of total demand met (inc. unmet need)
6. median/ mean response times

1.7.2.5 Results

Due to the way the simulation runs, Optima warn against using absolute counts of incidents, and rather use the relative change for comparison.

A summary of the best performing scenarios from the first round of modelling is illustrated below, with the main recommendations being to merge the mid and north Wales bases into a north central location, and extend hours to 02:00 by moving one of the 08:00-20:00 shifts to a 14:00 start. Retaining existing clinical staffing but altering shift patterns enables an additional 490 incidents to be responded to, with 486 patients. Whilst not a primary aim of the exercise, the response time also improves from 1 hour and 5 minutes to 54 minutes. 86% of demand is met in this scenario.

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21
Scenario 3 (car): then add a second 14h - 02h crew shift (car-only) to the merged base of scenario 2:					
3A car) Caernarfon	3,781	2,903	34%	1:00:07	26:35
3B car) Welshpool	3,737	2,857	34%	1:01:33	27:06
3C car) Conwy	3,834	2,954	34%	58:39	25:25
3D car) Denbighshire	3,840	2,960	34%	58:41	25:27
Scenario 3 (air): or allow the second 14h - 02h crew to also respond with a second helicopter:					
3A air) Caernarfon	3,964	3,083	36%	57:17	26:11
3B air) Welshpool	3,972	3,090	36%	57:27	26:27
3C air) Conwy	3,954	3,073	36%	57:14	25:38
3D air) Denbighshire	3,955	3,074	36%	56:40	25:50
Scenario 4 ("change"): continuing on scenario 3C/3D (car), change start time of Cardiff day shift to 14h:					
4A) Conwy car + change Cardiff	4,027	3,147	37%	58:53 **	26:24
4B) Denbighshire car + change Cardiff	4,034	3,153	37%	58:33 **	26:30
Scenario 4 ("car"): continuing on scenario 3C/3D (car), add a 14h - 02 crew shift (car-only) to Cardiff:					
4A) Conwy car + Cardiff car [#]	4,099	3,217	32%	54:13	25:04
4B) Denbighshire car + Cardiff car [#]	4,110	3,229	32%	54:35	25:16
** = The maximum number of scene arrivals in scenario 4 (change) is achieved by changing the Cardiff daytime shift to 14:00 hours. However, faster average response durations are achieved when changing the start time to 10:00 hours.					

Whilst these results are positive and revealed the best-case scenario, a number of limitations were identified by the service, including some coding of hospital transports, the impact of seasonality on the provision of a fourth helicopter, and the impact of unavailability due to technical, or weather issues. In addition, the use of response time as a measure includes many elements not in the control of the service, and so an additional measure, the reflex time was included which details the time from allocation to first vehicle on scene. This also takes into account the multiple response that occurs in certain incidents (e.g. multiple patients or requirement for additional clinical support).

These limitations were fed back to Optima, and also further work was commissioned to explore factors such as combining scenarios, the impact of aircraft unavailability, and hours of darkness within the day. It was determined that these would be tested as worst-case scenarios, including the inability to fly to an incident at all, the inability to fly in the dark to the scene (as per current operations from ¾ bases) and then work backwards from this worst-case scenario. This approach reflects earlier work during the development of the EMRTS, and has proven to be effective at predicting the impact of these factors through the various evaluations.

In order to test the hours of darkness flying impact, data was obtained from the current aviation provider by base, and an all-Wales average produced for hours of aircraft operation based on light levels as below. These were used to prevent the simulation from launching an aircraft to an incident outside of these hours, instead relying on a road response. The aim was to assess the impact of the hours of darkness capability on patients attended. With this, and other scenarios it should be noted that artificially shorter response times are seen, as the model tends to respond a shorter distance than an aircraft which essentially has unlimited range within Wales.

Abbreviation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aircraft start time	08:00	08:00	07:00	07:00	06:00	05:00	05:00	05:00	06:00	07:00	07:00	08:00
Aircraft end time	17:00	18:00	20:00	21:00	22:00	22:00	22:00	21:00	19:00	18:00	16:00	16:00

Based on this additional information and further work, the next set of scenarios were developed through data workshops, as below. These included elements of the 24-hour service expansion plan, such as the addition of a twilight car in Cardiff, for completeness.

Best performing +

5 = Second North Wales central Helicopter

6 = Helicopter for 6 months

7 = Daylight flying

8 = Permanent aircraft unavailability (moving Cardiff shift to right)

9 = Permanent aircraft unavailability (+Twilight Cardiff Car)

Scenario 5 and 6 were designed to test the acceptability of a fourth aircraft that has seasonal availability, and maintenance timed to coincide with lower demand. It revealed that the best timing for such an aircraft would be April-September, with an additional 64 scene arrivals occurring. During October – March, 27 additional scene arrivals occur. A 12-month helicopter has a net gain of 91 arrivals.

Scenario 7 was designed to test the impact of hours of darkness capability of the aircraft, and revealed 71 additional patients per year being attended if this was provided. The most disadvantaged areas are mid and west Wales, if not provided.

Scenario 8 was designed to test a no aircraft situation, and look at the impact of base location. It revealed that when compared with a north central location, Caernarfon had a net loss of 98 cases.

Scenario 8 & 9 reveal the importance of the aircraft, with a loss of 1132-1300 scene arrivals per year if not available.

Scenario 10 tested an additional twilight car shift from proposed and existing bases without a merged base (i.e. additional resource to existing or new site).

A summary of scenarios is included below from the Optima report (Appendix I Optima EMRTS Unmet Need Scenarios 05 - 10 (V4).)

Scenario	Dispatches	Scene Arrivals	Crew	Response	Veh. Reflex
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21
Scenario 3 (car): then add a second 14h - 02h crew shift (car-only) to the merged base of scenario 2:					
3A car) Caernarfon	3,781	2,903	34%	1:00:07	26:35
3B car) Welshpool	3,737	2,857	34%	1:01:33	27:06
3C car) Conwy	3,834	2,954	34%	58:39	25:25
3D car) Denbighshire	3,840	2,960	34%	58:41	25:27
Scenario 3 (air): or allow the second 14h - 02h crew to also respond with a second helicopter:					
3A air) Caernarfon	3,964	3,083	36%	57:17	26:11
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3C air) Conwy	3,954	3,073	36%	57:14	25:38
3D air) Denbighshire	3,955	3,074	36%	56:40	25:50
Scenario 4 (“change”): continuing on scenario 3C/3D (car), change start time of Cardiff day shift to 14h:					
4A) Conwy car + change Cardiff	4,027	3,147	37%	58:53	26:24
4B) Denbighshire car + change Cardiff	4,034	3,153	37%	58:33	26:30
4C) Caernarfon car +change Cardiff	3,985	3,104	37%	59:45	27:20
4D) Welshpool car +change Cardiff	3,954	3,073	36%	1:02:07	28:06
Scenario 4 (“car”): continuing on scenario 3C/3D (car), add a 14h - 02 crew shift (car-only) to Cardiff:					
4A) Conwy car + Cardiff car	4,099	3,217	32%	54:13	25:04
4B) Denbighshire car + Cardiff car	4,110	3,229	32%	54:35	25:16
4C) Caernarfon car + Cardiff car	4,057	3,175	31%	55:53	26:03
4D) Welshpool car + Cardiff car	4,028	3,146	31%	57:19	26:43
Scenario 5: similar to scenario 4B (“car”), but the 14:00 shift at Denbighshire is car/helicopter, instead of car-only.					
5) Denbighshire air + Cardiff car	4,203	3,320	33%	53:16	25:29
Scenario 6: a hybrid of 4B (“car”) and 5. The Denbighshire 14:00 shift is car-only, except from April until September:					
6) Denbighshire air (6mo) + Cardiff car	4,174	3,293	32%	54:07	25:22
Scenario 7: helicopters can fly during daylight only. These are variations of scenarios 4B, 5 and 6 above.					
7-4Bv1) Not applied to H67	4,079	3,198	31%	55:07	25:13
7-4Bv2) Applied to all shifts	3,937	3,056	30%	52:06	23:15
7-5v1) Not applied to H67	4,136	3,254	32%	53:34	25:04
7-5v2) Applied to all shifts	3,987	3,107	30%	51:21	23:17
7-6v1) Not applied to H67	4,127	3,247	31%	53:57	25:00
7-6v2) Applied to all shifts	3,985	3,105	30%	51:32	23:18
Scenario 8: poor weather (with 2 shifts in Cardiff, at 14:00 and 19:00 hours).					
8A) Conwy	2,810	1,941	22%	59:32	20:43
8B) Denbighshire	2,818	1,947	22%	58:21	20:45
8C) Caernarfon	2,680	1,811	20%	58:57	20:51
8D) Welshpool	2,611	1,740	19%	59:38	20:35
Scenario 9: poor weather (with 3 shifts in Cardiff, at 07:00, 14:00 and 19:00 hours).					
9A) Conwy	2,985	2,113	20%	54:35	20:13
9B) Denbighshire	2,987	2,115	20%	53:38	20:18
9C) Caernarfon	2,844	1,972	18%	53:30	20:16
9D) Welshpool	2,773	1,902	17%	53:27	20:05
Scenario 10: based on Scenario 1, add a 12-hour car-only shift at 14h – 02h at:					
10A) Caernarfon	3,878	2,997	29%	55:02	24:57
10B) Welshpool	3,857	2,976	29%	55:54	25:13
10C) Denbighshire	3,925	3,044	29%	53:26	24:05
10D) Ruthin	3,905	3,025	29%	53:40	24:21

1.7.2.6 Further sensitivity analysis

The data was presented to both EMRTS and WAA stakeholders, and well accepted, however further questions were raised around the clinical acuity of patients within the datasets through the internal data working group with staff representatives. Through working groups, a series of questions were determined, and further work conducted to explore these queries. This included further sensitivity modelling, and also extraction of the simulation results to enable further analysis within the NHS around patient conditions and outcomes.

The key areas include any new/ unintended "unmet need", despite a net gain, and the impact of an additional (5th) site in North Wales. The results of this work are outlined in Appendix F Optima EMRTS Unmet Need Scenarios 01 – 04 (V2) and Appendix G Optima EMRTS Unmet Need Scenarios 05 - 10 (V4).

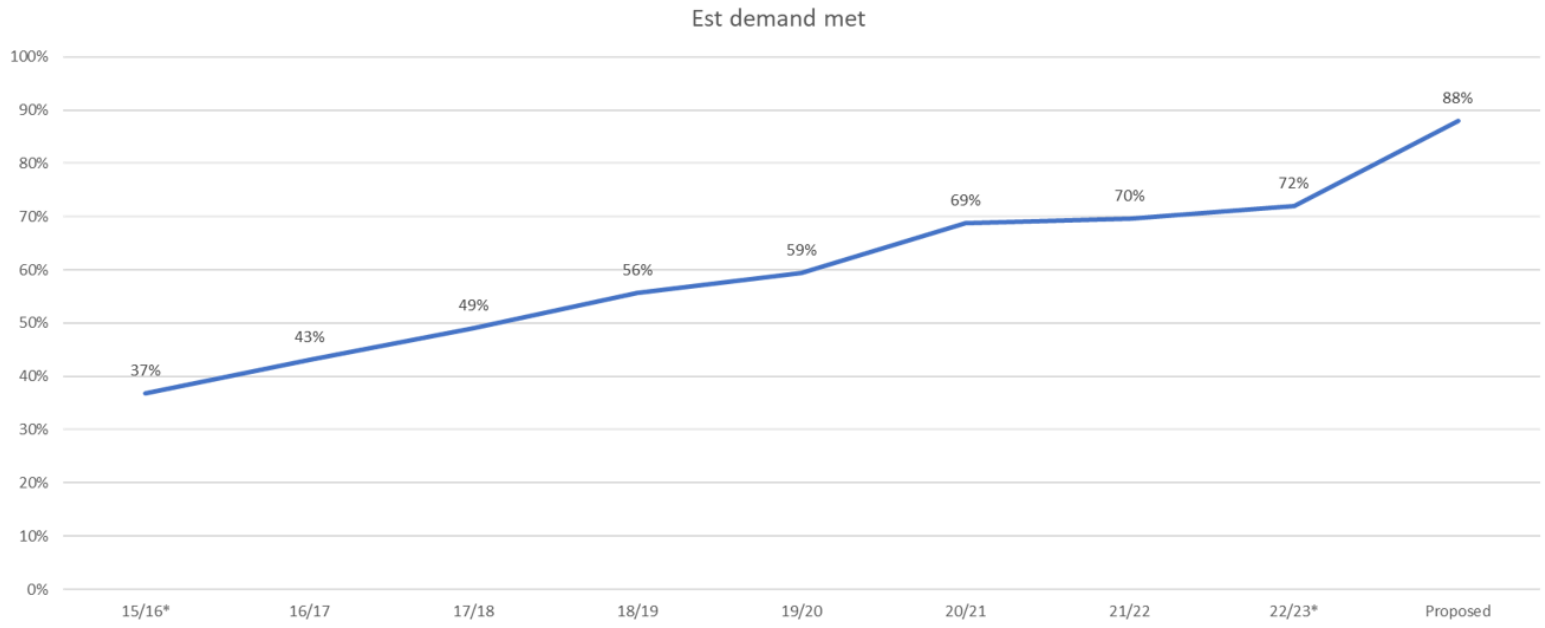
1.8 Stakeholder Feedback and response

Partial headlines of the proposed expansion were made public before the full report had been compiled, and whilst this impacted on the ongoing work, it provided an opportunity to listen to concerns, and explore these in detail. The EMRTS and WAACT jointly developed a set of frequently asked questions, and published these on the internet, as well as providing a number of briefings and written responses to multiple stakeholders.

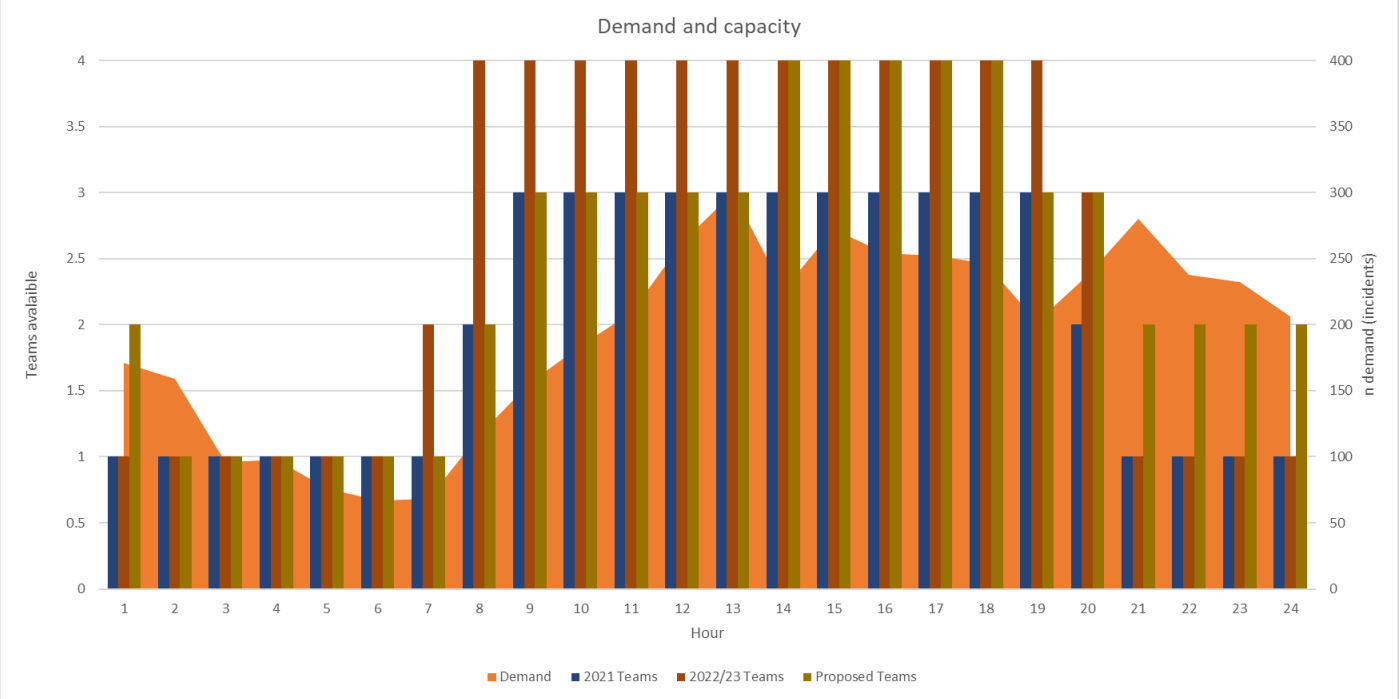
1.9 Overall outcome

The table and chart below combine work to date with actual and predicted service improvements.

FY NHS		Est demand met	increase	Changes	Teams / Hours
15/16*	y1	37%	0%	Service Start 2 bases (partial year)	2 / 12
16/17	y2	43%	6%	Swansea to Dafen base move, service bedding in	2/ 12
17/18	y3	49%	6%	Caernarfon expansion	3/ 12
18/19	y4	56%	7%	Twilight/ Winter pressures additonal resource, Cardiff base setup	3-4 / 12-18
19/20	y5	59%	4%	Twilight by road (prep for nights)	3-4 / 12-18
20/21	y6	69%	9%	Full Nights (by road initially)	4 / 24
21/22	y7	70%	1%	Full year effect of night HEMS	4 / 24
22/23*	y8	72%	2%	additional HEMS team in day (est/ partial year)	5/ 24
Proposed		88%	16%	Proposed model- optimised	5/ 24



In addition, a graphical representation of demand, versus capacity in terms of teams available by hour has also been compiled, to help illustrate the impact of the changes. This outlines the demand profile, as well as the number of teams available per hour across Wales.



1.10 Conclusions & Recommendations

The provision of a mobile 24-hour critical care service for Wales is a complex undertaking, and the service has taken steps to ensure that all service developments are based on the best available evidence at the time, whether clinical, academic or otherwise. The overriding factors in decision making are that of equity, patient outcomes and clinical and skills sustainability, in line with founding principles. Since planning started in 2012, a number of significant interventions have been made, largely through the investment in staff provision across Wales, with a stepwise expansion realising significant benefits following continuous monitoring and evaluation. The service has reached a steady state in terms of any outcomes that can be achieved through recruiting additional staff, or setting up additional sites, and so this latest change which requires significant infrastructure changes, as well as disruption to existing staff was based on a significant body of evidence.

There was also a clear risk around the perception by stakeholders and the public of changes to long-established sites, and so external data analysis was commissioned to independently assess the best course of action. When combining all evidence there is a strong suggestion that consolidating two underutilised teams into one site in North Wales, and staggering shifts to cover peak periods would be the best way to enhance the Service. The service should also maintain four aircraft with the use of a backup aircraft to cover downtime. The addition of night-vision capability during the hours of darkness, also is strongly recommended.

At the time of writing, the Cardiff day service (agreed in 2021) has been operational for 6 calendar months (from April 22), and is already showing significant impact both in terms of cases attended, but also in enhancement of the rural service through response or protection of the other three teams from urban calls in the South East of Wales. Whilst this aspect of the service will undergo routine monitoring and evaluation, it alone is only predicted to be responsible for 39% of the additional cases, and so the recommended model of a merged base is required to realise the remaining 61% of cases and effect the 16% increase in demand met. This is before taking into account the predicted activity uplifts over the coming years.

If agreed, then the changes would be subject to a formally managed programme looking at options for a phased implementation, with continuous monitoring and reporting to commissioners and the WAACT. The ongoing workstreams including procurement (Aviation and estates), staff impact, and funding will be in part informed by any final decisions by the WAACT. Any feedback gained through the engagement process will be included in this programme.

Possible additional modelling

Whilst significant effort has been made to take into account the impact of the weather on service provision, this still remains an area of concern for many stakeholders and based on feedback it is recommended that an additional piece of work to import meteorological data into the Optima model be undertaken. This would allow a complete simulation to be undertaken. Whilst the findings may not override all other factors taken into consideration around the proposed solution, it would enhance operational service planning. With the passage of time, it also enables the other simulation findings to be validated further with the latest data.

Emergency Medical Retrieval & Transfer Service Cymru

EMRTS

Annual Report

1 April 2021 – 31 March 2022

CONTENTS

Director's foreword

The last year has been a combination of returning to operational normality after COVID and continued service development. We attended over 3200 incidents with our primary EMRTS service and delivered much higher than predicted secondary critical care transfers with our newly launched *Adult Critical Care Transfer Service.*

After introducing a night service based in South Wales last year, we are, with the Wales Air Ambulance Charity, examining how to increase coverage to the population of Wales with our current resources. As an air ambulance organisation, we are almost unique in accessing an experienced external provider to deliver comprehensive modelling and analysis of existing data on emergency demand in Wales. We are exploring how we might better serve the population of Wales with timely and high-quality pre-hospital care. There appears to be a number of potential ways to alter our service delivery model to get to significantly more patients and decrease response times. The next phase of this project will be to work out how we can use this information to implement changes with our operational partners and carefully fine tune our service delivery to realise patient benefits and further improve outcomes.

The Air Ambulance Charity now supply us with fast response cars as well as helicopters. A combination of cars and aircraft deliver the best responses and allow us to respond in bad weather and to patients close to and far from our bases. Our new response cars are Volvo XC 90s in the same red livery as our aircraft and equipped with a comprehensive range of medical emergency equipment.

During the past year we have run several recruitment rounds for consultants and Critical Care Practitioners (CCPs). Many high-quality applications were received and after a tough selection process we have welcomed excellent new talent into our organisation. Several Consultants in shortage specialities have been recruited into the service and into Wales. Our CCPs have been formally recognised for the advanced skills that they bring to patients and continue to deliver a range of advanced skills seen in only a minority of UK air ambulances. An additional shift of CCPs and Helicopter Transfer Practitioners (HTPs) now deliver care during the daytime based from Cardiff heliport and have freed up the helicopter in South Wales to respond to emergencies further afield.

The service prioritises looking after patients and staff. We have welcomed a second follow up nurse to engage with patients and relatives after admission to hospital. We have also piloted a staff psychosocial care project delivered as part of a national initiative supported by the Royal Foundation. Since the launch of EMRTS every year has seen a significant service development. This year was no different and we look forward to next year as another opportunity to deliver equitable high quality pre-hospital critical care to the people of Wales.

Professor David Lockey, National Director EMRTS Cymru

Message from ACCTS Cymru Clinical Lead

The ACCTS Cymru team are pleased to join our EMRTS colleagues in the first published annual report since our launch in August 2021. As we pass the anniversary of our launch, we have the chance to reflect on unprecedented clinical and operational challenges faced during the pandemic and managing its aftermath.

In 2019 myself and the project team were charged with the task of developing a national critical care transfer service for the people of Wales. Just 24 months ago the transfer of the critically ill was delivered by ad hoc teams with minimal investment in system design, training, and logistics. The picture in Wales today is radically different. ACCTS Cymru provides teams of speciality trained intensive care consultants and senior doctors alongside practitioners supported by dedicated vehicles and state of the art equipment.

The mission statement of ACCTS is to provide uninterrupted provision of high-quality critical care irrespective of a patient's position on their clinical journey, allowing seamless transition between hospitals and critical care units. As those units recover from the pandemic and normal services resume, ACCTS Cymru has already become an essential and embedded part of safe and effective delivery of intensive care in Wales.

The service supports access to specialist care but also expedites care closer to home when specialist services are no longer required. It guarantees repatriation to local units ensuring flow through specialist services and maximising availability to those who need it most. ACCTS Cymru, in synergy with EMRTS supports the provision of a 24-hour service ensuring timely transfer for life-saving intervention for the people of Wales, maximising the benefit of both services.

Outside Wales ACCTS Cymru has catalysed the formation of operational and clinical partnerships with regional transfer teams and quaternary services and begun to expedite access to these expert centres such ECMO and other forms of mechanical support. ACCTS Cymru also represents Wales in the nationwide move to professionalise transfer medicine, working with services across the country, refining and sharing clinical and operational expertise, allowing us to contribute to shaping the landscape of transfer medicine nationally and internationally.

We have far exceeded our predicted operational demand and facilitated the transfer of sicker patients, who traditionally would have been too unwell, demonstrating the clinical benefit of recruiting high-quality clinicians from inside and outside Wales alongside an evidence-based, effective and well-governed operating model.

I am immensely proud of what ACCTS Cymru has achieved during our short existence and we will continue to move forward as a vanguard of transfer medicine.

Dr Mike Slattery, ACCTS Cymru Clinical Lead

Our Mission

To provide advanced decision-making and critical care for life or limb-threatening emergencies that require transfer for time-critical treatment at an appropriate facility.

Our Vision

EMRTS Cymru has been developed to provide the following services to Wales:

- EMRTS Cymru delivers equity of access to pre-hospital critical care for the people of Wales.
- EMRTS Cymru delivers health gains through early interventions (provided outside of normal paramedic practice by EMRTS Cymru) and direct transfer to specialist care centres. This aims to improve the functional outcomes of a patients and increase the number of 'unexpected survivors.'
- EMRTS Cymru delivers downstream benefits for hospitals across Wales. More patients are taken directly to the most appropriate centre with fewer requirements for secondary transfers which previously would have depleted hospitals of specialist personnel (such as anaesthetists) and created an additional cost for the Welsh Ambulance Service.
- EMRTS Cymru delivers benefits to smaller and more rural hospitals across Wales. More patients are taken directly to the most appropriate centre which results in significantly fewer secondary transfers. These would previously have depleted hospitals of key specialist personal (such as anaesthetists), created additional cost

and pressures for the Welsh Ambulance Service and delayed time to definitive care in specialist centres.

• EMRTS Cymru delivers clinical and skills sustainability in Wales. EMRTS supports Consultant and Critical Care Practitioner (CCP) recruitment into Wales by offering opportunities with the service as part of the recruitment of related NHS Wales hospital position. EMRTS Cymru also supports educational activities across NHS Wales.

Our Service

EMRTS offers a 24/7 medical operation across Wales. Services include:

- Pre-hospital critical care for all age groups (i.e. any intervention/decision that is carried outside standard paramedic practice).
- Undertaking time-critical, life or limb-threatening adult and paediatric transfers from peripheral centres (including Emergency Departments, Medical Assessment Units, Intensive Care Units, and Minor Injury Units) for patients requiring specialist intervention at the receiving hospital.

In addition, the service provides an enhancement of neonatal and maternal pre-hospital critical care, both for home deliveries and deliveries in free-standing midwifery-led units (MLUs), including the transfer of neonatal teams to distant time-critical cases by air.

The service provides a multitude of roles at major incident or mass-casualty events and a strategic medical advisor is available 24/7. This advisor is known as a top cover consultant.

When the Wales Air Ambulance Charity helicopters are unable to fly due to poor weather conditions, EMRTS Cymru has access to a fleet of Rapid Response Vehicles (RRVs). They have been converted into state-of-the-art emergency response vehicles designed to enable the team to reach the scene of a medical emergency, by road, as fast as possible. These vehicles are stationed on all of the EMRTS bases in Wales. Medical equipment has been designed to be interchangeable between the Charity's helicopters and the RRVs.

EMRTS Cymru is coordinated and tasked centrally via the Critical Care Hub (CCH) which is based at the Welsh Ambulance Service headquarters in Cwmbran. The CCH also operates 24 hours a day.

ACCTS

The Adult Critical Care Transfer Service launched in August 2021 as a result of the Critical Care working group task and finish report (2018). The report recognised the requirement for safe and high-quality inter-hospital transfer to be an essential part of critical care of delivery in Wales. Prior to the services formation, critical care transfers were undertaken on an ad-hoc basis by medical and allied health care professionals from referring hospitals utilising front line ambulances. This ultimately resulted in increased pressures on the medical teams, both in hospital and prehospital, by depleting the already stretched resources.

The service is designed to be streamline and maximise the access of Welsh patients to specialist services located across the national hospital network.

The predicted workload was initially estimated that 420 transfers each year. This number was exceeded within ten months of launching the service and the first-year totals are expected to exceed 500 transfers.

ACCTS maxim is that critical care is a process and not a location. The service aims to deliver seamless, uninterrupted, high-quality care while the patient is in transit and can continue the care provided in any intensive care unit. The service can provide varying levels of care from complex treatment and interventions to lower acuity critical care transfers between hospitals. It has funded three ambulances, operated by two transfer

duty crews. ACCTS is able to provide this service by recruiting high calibre clinicians who have all undergone a robust selection process and have delivered Critical and Intensive Care in previous roles.

A day in the life of ACCTS

Pictured: Meryl Jenkins, ACCTS Retrieval and Transfer Practitioner who takes over as ACCTS new Service Manager in September.

The service is divided into a north and south team. The south team begin their day at 8am where they carry out check listed tests of their equipment. The service is predominantly road-based and has in part of its crew a critical care transfer assistant who is qualified to drive vehicles using blue lights - having undertaken an emergency advanced driving course. The team makes ready the specialist critical care vehicle used to transfer patients for that day.

Critical care medications are checked and booked out to use for the day and the team makes ready the specialist critical care vehicle that will be used to transfer the team and patients that day.

One of the specialist Retrieval and Transfers Practitioners act as the national critical care transfer coordinator and every day they lead the national critical care SITREP call, attended by ward managers and senior doctors of all the units across the north and south network across Wales.

The ACCTS coordinator then communicates with hospitals to establish which patients require transfer for that day and gain a global overview of capacity and triage and discuss patients with the various units who are likely to be part of facilitating the required access to specialist care that the cohort of patient may require. Or, to move that patient.

The coordinator acts as a central point of contact for all critical care transfers in NHS Wales, supporting the clinical care of the patients during transfer as well as streamlining the logistics of transfer.

The ACCTS teams are mobilised from either Cardiff or Bangor. The North team offer a 24-hour service allowing an on-site team mirroring south hours throughout the day and then an on call-service from 8pm through to 8am. Transfers could involve inter-hospital transfers, a patient being repatriated to a unit closer to their family - time critical transfers for emergency surgical procedures and interventions, or being transferred to a specialist centre for Interventions unavailable in their current hospital.

Regularly the service will be tasked to transfer or repatriate patients beyond the borders of Wales to any patients that require services outside of Wales or need to be repatriated back. ACCTS is able to work with colleagues at EMRTS and the Wales Air Ambulance and with extra training to crews around aviation operations, some RTPs are able to work on board the aircraft to facilitate transfers that will benefit their patients.

If there are no active transfers within the network these teams carry out several duties on base, including training and development, clinical research, auditing tasks and simulation training.

ACCTS has developed working relationships with a number of hospitals, and invites anaesthetics and intensive care trainees to undertake observation and clinical shifts with them to ensure trainees can develop transfer skills as part of their professional development. This in turn enhances the service and develops a pool of

physicians for future recruitment and ultimately improved care for the patients of Wales.

ACCTS operational lead Gareth Evans said:

"We are a dedicated transfer service attached to an already established and widely respected emergency medical service. It is all about ensuring the right team for the right patient at the right time.

It does not necessarily matter who the team are, as long as the right skill of the clinicians is delivered to the patient.

The key focus of this service is its utility for patients of Wales. As a devolved nation we can have the scope to be doing things differently to other services and we are unique in what we do.

We are able to be more dynamic in how we develop, and the general view is that we are leading the way on several fronts.

We are very proud that other services are looking at us and what we are able to achieve. That gives us as clinicians and managers the drive to perform even better.

We are all massively proud to be a flagship service for Wales."

The Wales Air Ambulance Charity

What is the difference between EMRTS Cymru and the Wales Air Ambulance Charity?

What is the Wales Air Ambulance Charity?

Launched on St David's Day 2001, the Wales Air Ambulance Charity is the official air ambulance service for Wales. The Charity relies entirely on donations to raise approximately £8 million each year. This funds four helicopters across Wales and the service's fleet of rapid response vehicles. It is the largest air ambulance operation in the UK.

Income generation ranges from community fundraising, legacies and corporate support, to a national retail and trading operation as well as a Lifesaving Lottery.

The service has attended over 42,000 missions since its inception.

The Charity's Mission

To deliver lifesaving, advanced medical care to people across Wales, whenever and wherever they need it.

The Charity's Vision

To improve the lives of patients and their families by being a world leader in advanced, time-critical care.

For more information about the Wales Air Ambulance Charity, visit www.walesairambulance.com

Governance Structure

EMRTS Cymru has developed a robust system of organisational and clinical governance. The service is hosted by Swansea Bay University Health Board (SBUHB) and is commissioned by the Emergency Ambulance Services Committee (EASC).

The organisational governance structure consists of an EMRTS Delivery Assurance Group (DAG) which sits as a subcommittee of EASC. The DAG is responsible for the delivery, direction, and performance of the Service.

The EMRTS Cymru National Director is accountable to the DAG for the delivery and performance of the service and to the SBUHB Chief Executive for organisational and clinical governance.

Internal governance is led by the EMRTS Clinical and Operational Board which is attended by senior EMRTS personnel and support services and manages clinical and operational issues relating to the service.

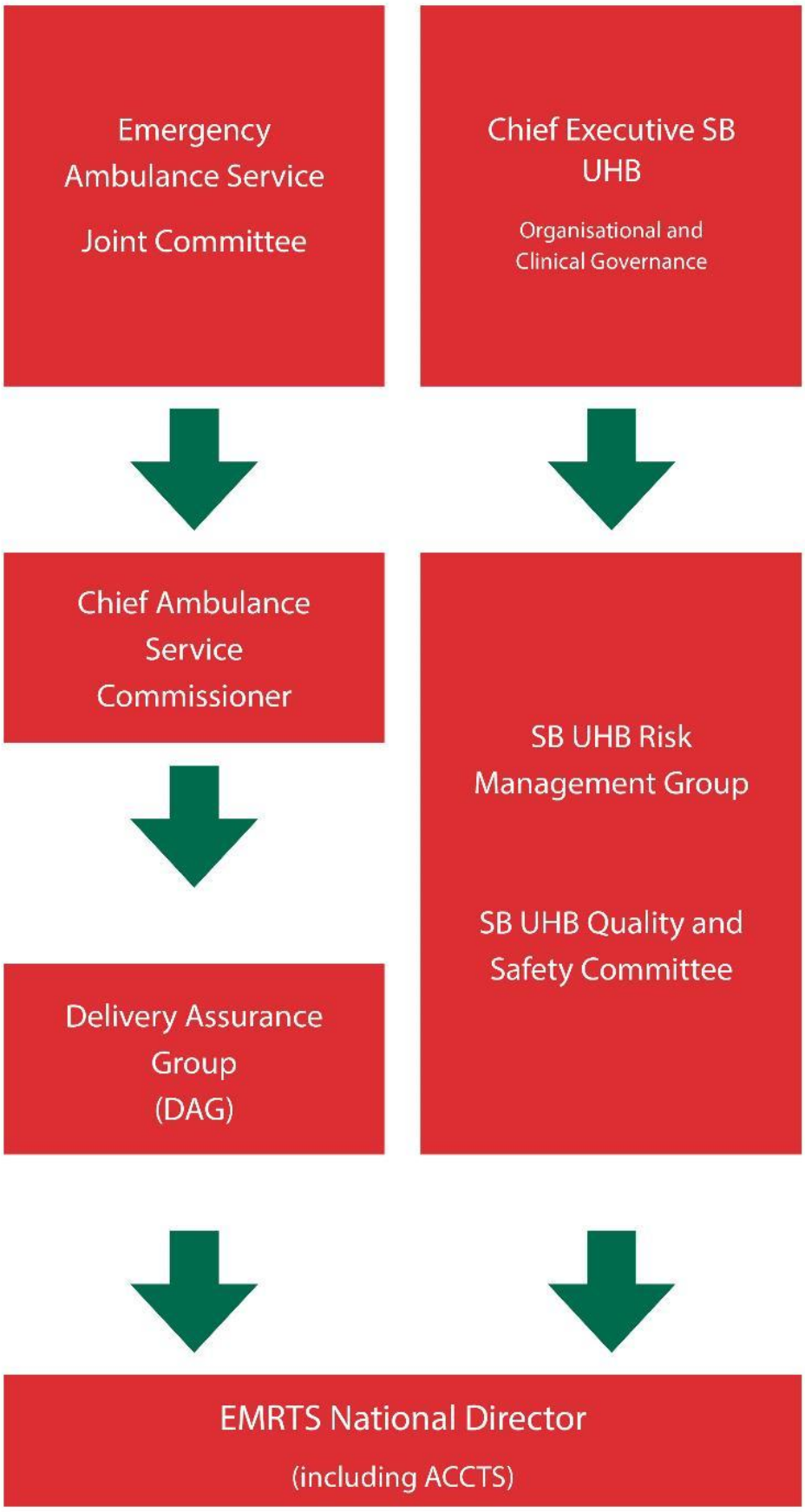
The Board meets on a bi-monthly basis and is supported by the work of several specialist sub-groups.

There are a number of supporting documents underpinning the organisational governance of the service as follows:

- National Collaborative Commissioning Quality and Delivery Framework - namely CAREMORE.
- Terms of Reference for the EMRTS DAG.
- Collaboration Agreement between SBUHB, the Wales Air Ambulance Charitable Trust (WAACT) and the Welsh Ambulance Service Trust (WAST).
- Memorandum of Understanding between SBUHB and other Welsh health boards and trusts.
- Service-level agreement between EMRTS and SBUHB for accessing support services.
- Terms of Reference for the EMRTS Clinical and Operational Board.

An External Clinical Advisory Group (ECAG) was established at the inception of the service in 2015. The ECAG provided benchmarking of clinical standard operating procedures and independently reviewed significant adverse events, reporting their findings back to the Clinical and Operational Board.

A new External Clinical Advisory Panel (ECAP) has now been established in place of the ECAG. The new expert panel provides ad hoc advice on specialist issues when requested and input to a Clinical Governance Day when relevant issues are being presented.


Emergency Ambulance Service Joint Committee
Chief Executive SB UHB
Organisational and Clinical Governance
Chief Ambulance Service Commissioner
SB UHB Risk Management Group
SB UHB Quality and Safety Committee
Delivery Assurance Group (DAG)
EMRTS National Director
(including ACCTS)

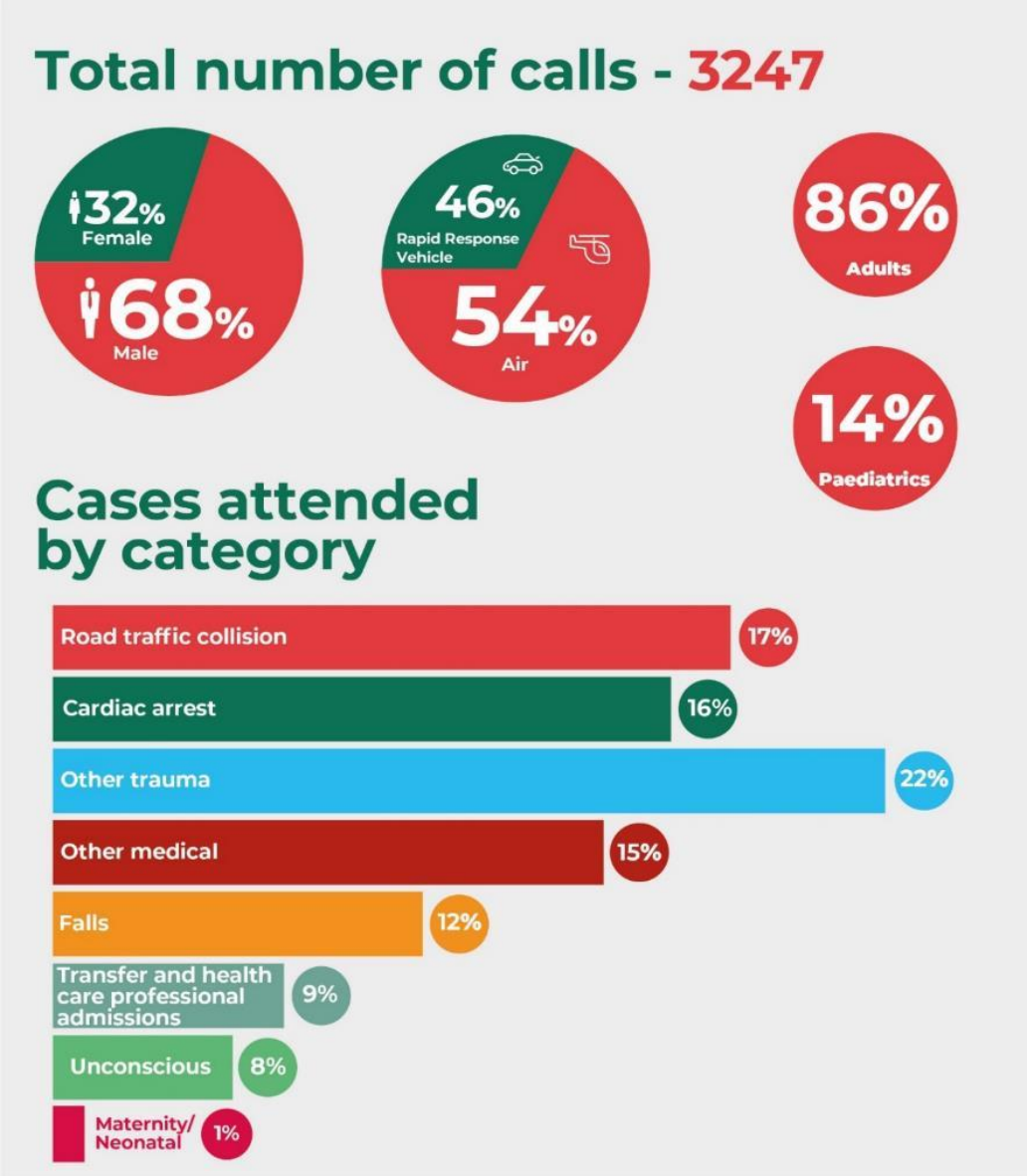
Financial Statement

EMRTS Cymru met its financial target in 2021/22 by delivering a surplus of £277k against its revenue funding allocation of £7.45 million.

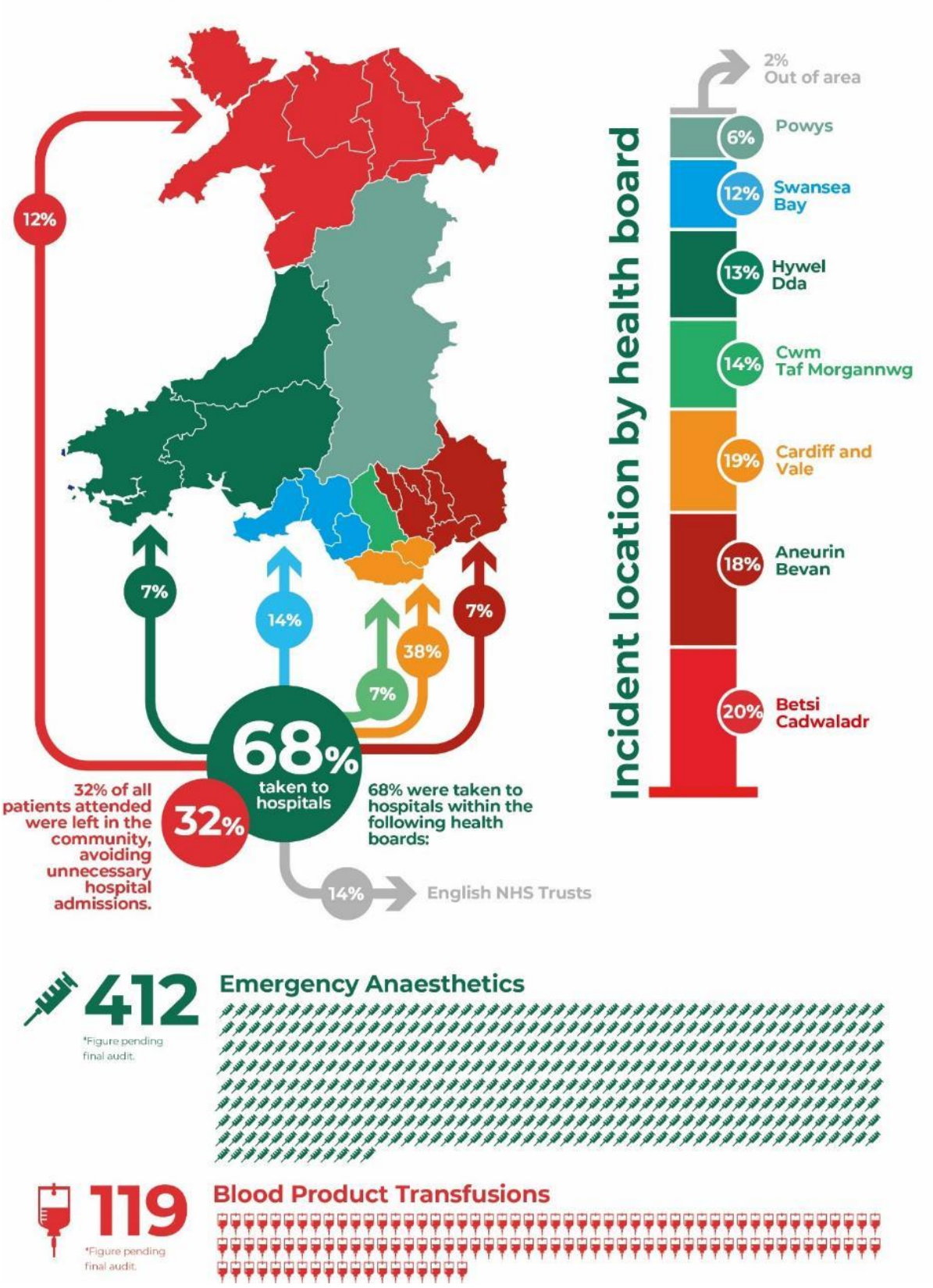
The surplus arose primarily as a result of the Covid-19 pandemic and global supply chain issues – it will be carried forward into 2022/23 to support the ongoing delivery of the service.

The Wales Air Ambulance Charitable Trust has agreed to fund future Rapid Response Vehicle purchases to increase the response capability of Critical Care Teams. EMRTS would like to thank the Charity for their support as we continue to work collaboratively for the people of Wales.

Preliminary annual performance data



Patient Destinations



EMRTS Service Evaluation

The EMRTS evaluation published in March 2022 covered a five-year period between 2015 and 2020 and offers significant evidence that EMRTS Cymru is achieving the aims set out in its business justification case.

It sets out the findings from the second phase of the service evaluation of EMRTS, following on from the first report which provided an early overview of year one activity.

It clearly demonstrates the increasingly important role of the service in providing an emergency response for those who need immediate treatment. It also shows the positive impacts it has had on the development and delivery of specialist emergency care practice in Wales.

The recommendations of the initial report have been realised, including expansion to North West Wales, and further evaluation of the unmet need outside of initial daytime operating hours. This culminated in the expansion of the service to a 24/7 airborne operation from December 2020.

Key findings include:

- The introduction of EMRTS was associated with a significant reduction (37%) in 30-day mortality for patients with blunt traumatic injury
- Emergency inter-hospital transfers were reduced by 41%
- Increased number of patients were delivered to the right hospital first time: 42% of patients bypassed local hospitals to be taken directly to more specialist care.
- Critical interventions were available outside hospital where necessary:
    - 63% (6,018) of patients attended received interventions that are outside standard ambulance service practice.
    - 313 patients received blood product transfusions.
    - 790 patients received pre-hospital anaesthesia.
- Significantly, twelve new consultants have been recruited into Wales due to the attraction of posts that include formal pre-hospital care sessions with EMRTS. Another thirty-two part-time consultants who also work in key specialities in NHS hospitals are employed to deliver the clinical service.
- There are also well-established programmes developing the future medical workforce including Pre-hospital Emergency Medicine (PHEM) subspecialty training, clinical fellow schemes, and the clinical attendant scheme.

A message from the Minister for Health and Social Services

"I am delighted to see how far the EMRTS Service has come since its launch in April 2015 and achieving its ambition to become a 24/7 service, in partnership with the Wales Air Ambulance Service.

The development of the EMRTS Service over the last seven years has supported rapid change within critical care to ensure we have the right services in the right place for people who are critically ill. The new dedicated Adult Critical Care Transfer Service Cymru (ACCTS) which commenced in South Wales in August 2021 and in North Wales in October 2021, is another important part of plans for improving adult critical care services.

The work of the EMRTS in partnership with the Wales Air Ambulance Service and its hardworking staff has helped Wales to lead the way in best practice, clinical excellence and innovation.

The publication of these positive findings on 1st March coincided with the 21st birthday of the Wales Air Ambulance Charity. It has been a pleasure to see the charity go from strength to strength since its launch on St David's Day in 2001. The work of the charity and its' hardworking staff and volunteers has contributed to the charity becoming the largest air ambulance operation in the UK.

The evaluation will support ongoing service improvement and expansion activities and I look forward to seeing the service continue to develop and improve patient outcomes and experience."

Eluned Morgan
Minister for Health and Social Services

EMRTS Patient Liaison

EMRTS Cymru has a provision for patients that have been treated by its critical care teams. Many of the people the service has helped will have received critical care treatment at the scene but will have little memory or understanding about what happened to them.

In addition, relatives often have many questions regarding pre-hospital care. Through the aftercare service, and EMRTS Patient Liaison Nurse Jo Yeoman, pictured, some of these gaps can be filled.

Recovery from critical illness or injury can be long and challenging as people move between different departments, hospitals and rehabilitation centres before finally returning home. Through the patient liaison service, EMRTS is able to support patients and relatives on that journey, providing consistency and support throughout, including after discharge home. This support may include follow-up visits at varying intervals during recovery and will differ from patient to patient depending on their need. It could be shortly after admission or after they have been discharged home, depending on how long their recovery is. The main purpose of these visits, and supporting correspondence, is to explain what has happened at the scene whilst giving emotional support to both patient and relatives.

Hayley Whitehead-Wright has also been employed to the new post for Patient Liaison Nurse in north Wales. A nurse for almost 15 years, she was part of Wrexham Maelor Hospital's follow-up and bereavement team, providing support for patients and relatives who had experienced time on the hospital's ICU unit. The aftercare service has further expanded to include Julie Whittaker as a patient liaison administrator, who manages all patient correspondence and bookings, providing much needed admin support to both nurses.

A close working relationship has developed with some of the major hospitals which allows a multidisciplinary team approach to patient care, improving communication for all involved. Links have been made with other third sector organisations so, for patients that have had life-changing illnesses or injuries, there is a variety of support that is made easily accessible, and EMRTS will be able to act as a point of contact.

This support also extends to all those who work for EMRTS and who are involved directly in incidents or patient visits, which is being formalised by the introduction of a peer support programme.

Sadly, some patients do not survive and it is important that their loved ones are supported during this difficult time, so a Bereavement Aftercare Service is offered to all relatives. This gives them the opportunity to ask questions, find out what treatment was given and also provides a safe space to talk about their grief.

For more information about the **Patient Liaison Service**, email emrts.patient@wales.nhs.uk or call 0300 3000 067.

Case studies

Nathan Ford

Welsh triathlete Nathan Ford was sadly paralysed from the neck down in 2021 after falling from his bike during a race in Scotland.

But now, following months of care and rehabilitation, he is beginning to take his first steps again with the help of a frame.

Nathan was flown from Dundee to Wales by the Wales Air Ambulance with both EMRTS and ACCTS clinicians on board, along with a host of high-tech critical care equipment.

Nathan, pictured here before his accident, was competing in the British Triathlon Championships in Aberfeldy last August when he came off his bike at high speed. Fortunately, a doctor also competing in the event and stopped to perform CPR, and the 38-year-old was taken to intensive care in a Dundee hospital where he remained for four weeks.

Nathan then needed to come back to Wales for ongoing critical care and rehabilitation but moving him safely to Cardiff required precision planning.

He was flown back to Wales by Wales Air Ambulance, with one of the ACCTS clinicians on board the aircraft offering the additional specialist level of critical care expertise needed to move a patient in Nathan's condition.

Nathan said:

"I don't remember anything from the accident, and I was put into a coma when I got to hospital. The first part of my stay was a bit of a blur, because of all the medication. A few days before I was due to come home there was a lot of planning. There were high winds, and they were trying to find a

suitable time with the weather. I was sedated for the journey, so I do not remember any of it at all".

Nathan was diagnosed with two life-threatening injuries; a spinal injury and a brain injury, although the latter was not as severe as initially thought. He underwent an operation to put a metal plate in his neck, which slipped necessitating a further operation to stabilise the fractures in his neck, followed by 14 weeks with wearing a 'halo'.

He began his physiotherapy in Cardiff, but after more than 200 days in hospital he discharged himself and has been undergoing a programme of rehabilitation ever since.

"When I woke up in hospital in Scotland the consultants were saying to my family it was touch or go whether I would survive or not. But I am making good progression, although it is very small steps. Initially I was told I would barely be able to move my legs, and I was told I would be on a ventilator for the rest of my life, and I would not be an independent person again".

However, Nathan had a tracheostomy which led to him being able to breathe independently, and the good news is he has now started taking steps with the aid of a frame, as his rehabilitation continues.

The 38-year-old from Killay in Swansea said:

"I was also told if I had not been as fit as I was, I would not have survived. I was in the best shape of my life - I've got the triathlon to thank for that. It has allowed me to make progress, mentally as well. And without my wife by my side there is no way I could have done what I have done. I owe her everything, she is so supportive in everything I do. The people who helped me will never truly understand just how thankful I am because they were 'just doing their job' I literally owe them my life, along with everyone else involved."

How Nathan's journey home was planned

Hannah McGarvey, ACCTS Retrieval and Transfer Practitioner, helped to plan Nathan's journey home.

She said: *"Extensive planning was undertaken over the course of a few days due to the length of transfer to maintain Nathan's and the crew's safety and also provide ongoing critical care.*

Logistical concerns included the weather and how many refuel stops were needed and where. These were calculated based on the weight of the additional specialist equipment and the people on board.

We also had to consider timings so that the pilots wouldn't run out of 'fly time' and the aircraft to be back in Cardiff for the night staff."

Great care was also taken over the critical care that Nathan might need on board.

Hannah explained: *"We needed to make sure we had all equipment available in case of any emergency, for example if Nathan lost his airway. There was a full airway kit ready to reinsert a breathing tube; blood pressure medication ready in case his blood pressure dropped, and emergency drugs ready in case he had a cardiac arrest, plus many more. Nathan had infusions ongoing during the transfer so we had to ensure there was enough battery on the pumps, enough battery on the ventilator which was breathing for him and also that we had enough syringes of drugs to last the length of the journey."*

The crew configuration was made up of Scott Bradburn ACCTS Consultant, Andrew Morris EMRTS HTP and the two Babcock pilots.

Jean Love

Gran-of-six Jean Love unfortunately suffered life-threatening injuries after being knocked unconscious while staying at a holiday cottage in Lampeter.

The Wales Air Ambulance responded to an emergency call for the 77-year-old, and its crew discovered Mrs Love with bleeding from her nose and right ear - signs of potential severe head injury.

To prevent further injury the patient was given general anaesthetic, with a breathing tube inserted into her airway and connected her to a breathing machine.

She was flown to the major trauma centre at Royal Stoke University Hospital where it was revealed she had suffered extensive traumatic brain injury, multiple fractures of her skull, collar bone, ribs and two bones in her lower back.

Mrs Love was admitted to a neurological ward and over the next three days her conscious level remained low, and her family assembled around her bed to say goodbye after being warned she may not survive.

However, her condition began to improve significantly.

After 20 days she was transferred to the Royal Stoke University Hospital and then the Walsall Manor Hospital nearer her home. From there she went to the Samuel Johnson in Lichfield for rehabilitation before being discharged eight weeks after her fall. Her recovery continues and her family said *"nobody would ever think she's had such a serious accident."*

Son Phil added: *"I don't think the importance of the Wales Air Ambulance service can be underestimated. Without it, it's unlikely that Jean would have survived, and even if she did, I'm not sure she would have recovered as well as she has done."*

Anonymised case studies

EMRTS

Our Helimed 57 team from Dafen attended a 13-year-old girl who had collapsed suddenly.

The crew arrived on scene in Morriston, Swansea, within 20 minutes of the emergency 999 call and carried out a rapid assessment.

The young teen had four seizures in total, which had stopped on their arrival, but she remained very drowsy and confused.

The patient was connected to some monitoring and a line inserted into her hand to give her medication intravenously. As they were transferring her to the road ambulance, she began to have another seizure, so they had to administer some strong sedation.

Concerned that a possible bleed to the brain was causing the seizure, the crew decided to give her a general anaesthetic and put her on a ventilator. This not only helped protect the brain and reduce the seizures but also ensured her airway was protected to enable a safe transfer.

Once stabilised, the Helimed team travelled with her to the specialist neurosurgical centre, bypassing her local hospital, to get her to the time-critical specialist services she needed.

When she arrived at hospital, she underwent urgent surgery on her brain to reduce the pressure and was then admitted to the paediatric intensive care unit where she spent just over a week before being discharged to the children's ward.

Just under 2 months after her initial collapse she was discharged home with her family and has continued to make a good recovery.

ACCTS

A patient on intensive care underwent an emergency re-intubation (siting a breathing tube into the airway to allow safe ventilation of the lungs and allow her to be placed on a ventilator.) Due to a previous tube, her airway was dangerously swollen and the tube could not be passed.

The specialist ENT (ears/nose/throat) team performed an emergency tracheostomy tube on the ICU. Due to ongoing difficulties the patient required complex surgical interventions and a unique ventilation strategy.

The patient, from the Newport Gwent area, required transfer from South Wales to London to a centre with specialist airway surgical expertise and ECMO capability. ECMO is a machine which pumps blood out of a patient's body to be oxygenised, allowing their lungs to rest.

Careful planning and preparation was made given the complexity of her critical care and ventilation needs. The specialist intensive care and transfer consultant-led team prepared and drilled for managing a patient on two ventilators, including the necessary equipment and procedural adaptations to

manage any patient deterioration. The ACCTS standard transfer trolley configuration was modified by mounting two ventilator brackets plus necessary additional physiological monitoring devices to monitor the patient's vital signs.

Following a bedside discussion with the referring intensivists and ENT surgeons, the patient was moved onto the ACCTS trolley, ventilators, infusion pumps and monitoring equipment. Following standard safety checklists, the patient was moved to the ACCTS vehicle and then conveyed to London without complication.

She required constant monitoring of her breathing tubes and ventilation, while maintaining infusions of sedation, analgesia, and paralysis. Her care was successfully handed over to the London team. Two weeks later her condition was stable with only one breathing tube and ACCTS conveyed her back home to South Wales.

We are delighted to report that she made a full recovery to hospital discharge.

3 Appendix B EMRTS Short-Term Strategy 2020

Introduction

WAAC Trustees have recently advised that they are considering the Charity's long-term strategy over coming months. EMRTS will contribute to this by sharing data and experience-based clinical / operational opinion in the last quarter of 20/21.

In the interim EMRTS have been asked to provide short-term options to increase the use of Helimed 67. This has been achieved by reviewing service clinical data to understand the implications of possible changes to the Cardiff and wider EMRTS operation and how that feeds into the Charity's immediate strategic direction going forward.

Short-Term Solution – H67

A small group of EMRTS Clinical and Operational Board members have considered the relevant constraints and dependencies. A range of options were then explored using the key investment objectives (established with Welsh Government prior to the establishment of the service). These objectives are health gain, equity, clinical and skills sustainability, affordability and value for money. These are closely aligned with the Charity's objectives. Data is also used to support the appraisal of these options in order to demonstrate how they meet each of the key investment objectives.

Constraints and dependencies

Potential constraints include:

- Optimal use of existing operational bases
- The need to provide the existing level of equity in terms of service delivery
- Use of both an air and road response
- Recruitment of the required workforce
- EMRTS Critical Care Hub (previously the Air Support Desk) operating from Vantage Point House (WAST Clinical Contact Centre, Cwmbran)

Dependencies (what must be in place to enable the strategy) include:

- Charity support
- Commissioner and stakeholder support
- Additional recurring revenue funding availability from the Charity
- Recruitment of the required workforce

Short-Term Strategy - Key principles

These include:

- Improved utilisation and more effective tasking of H67
- More efficient and effective utilisation of critical care skills, equipment and resources

Options – short-list

Having considered a number of options, these were reduced to the shortlist below that meet the key investment objectives outlined above.

Option Ref	Option Detail
1	**Do Nothing:** **Cardiff (day):** Helimed 67 - HTP and x2 Pilots **Cardiff (night):** HEMS - Doctor, CCP **Dafen (day):** HEMS - Doctor, CCP and x1 Pilot
2	**Enhanced HEMS service #1:** **Cardiff (24/7):** HEMS - Doctor, CCP and x1 pilot (daytime) x2 Pilot night **Dafen (day):** HEMS - CCP, HTP and x1 Pilot
3	**Enhanced HEMS service #2:**

Cardiff (day): HEMS - CCP, HTP and x1 Pilot

Cardiff (nights): HEMS - Doctor, CCP and x2 Pilots

Dafen (day): HEMS - Doctor, CCP and x1 Pilot

Data Analysis

The selection of the preferred option is undertaken by considering a range of the agreed investment objectives. The table below provides an overview of the factors for each option supported by modelling data.

Data sources include Welsh Ambulance Services operational data, and EMRTS clinical and operational data covering a three-year period. Where a range has been given, this relates to a range on scenarios based on aircraft availability using operational data (the higher number is in the absence of an aircraft, the lower number assumes previous availability over a three-year average). It is assumed that where a physician is required at a case (e.g. for anaesthesia or level 3 critical care transfer) a closer team may have made an initial response to stabilise the patient. In many cases it is not apparent that such course of action is required until a team is on scene, and these patients often benefit from additional team members and resources (e.g. multiple patients, or multiple procedures required).

For illustrative purposes data pertaining to the current average workload volume, predicted "unmet need", and predicted physician requirement have been plotted (by locality) as a heatmap below, the focus of these points are centralised for each region (rather than representing exact location 'hot spots'). Purple shaded areas represent 20-minute drive times from base locations.

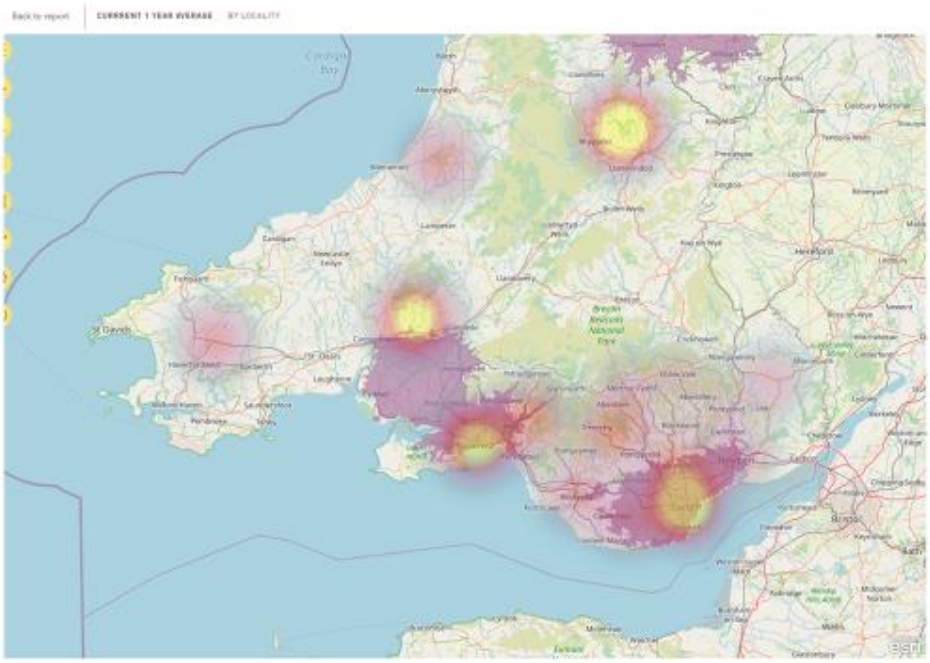


Figure 1 Current average workload heatmap

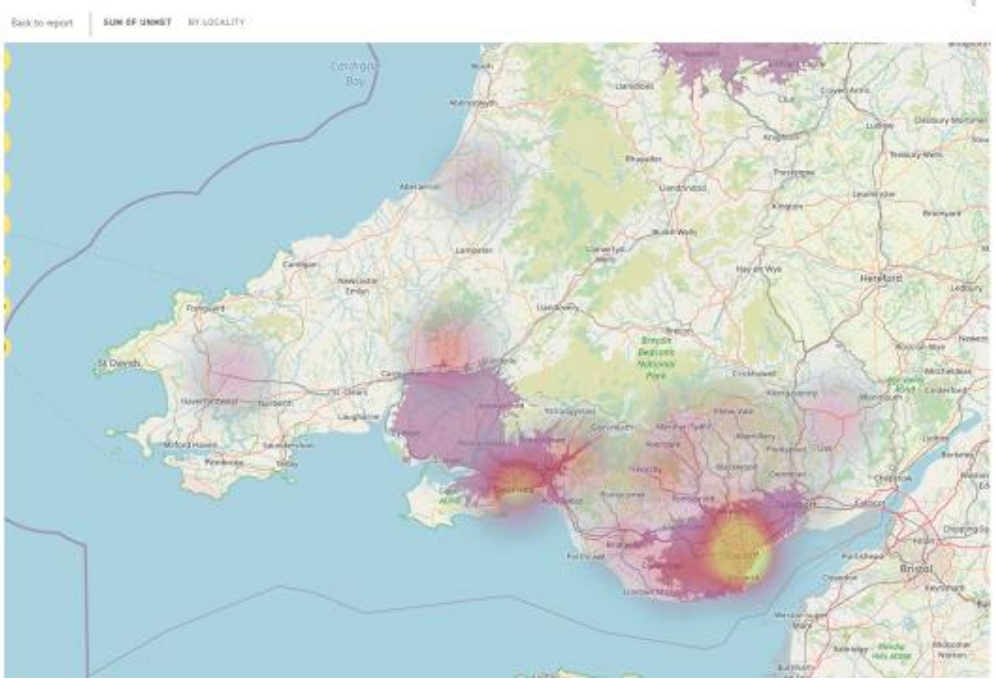


Figure 2 Unmet need heatmap

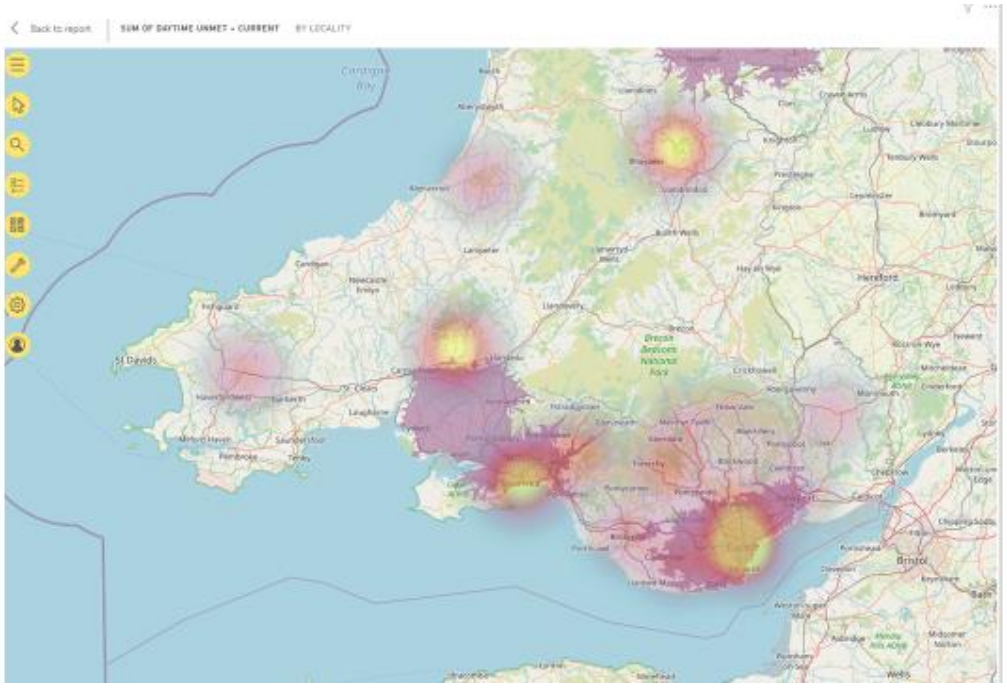


Figure 3 current workload + unmet need heat map

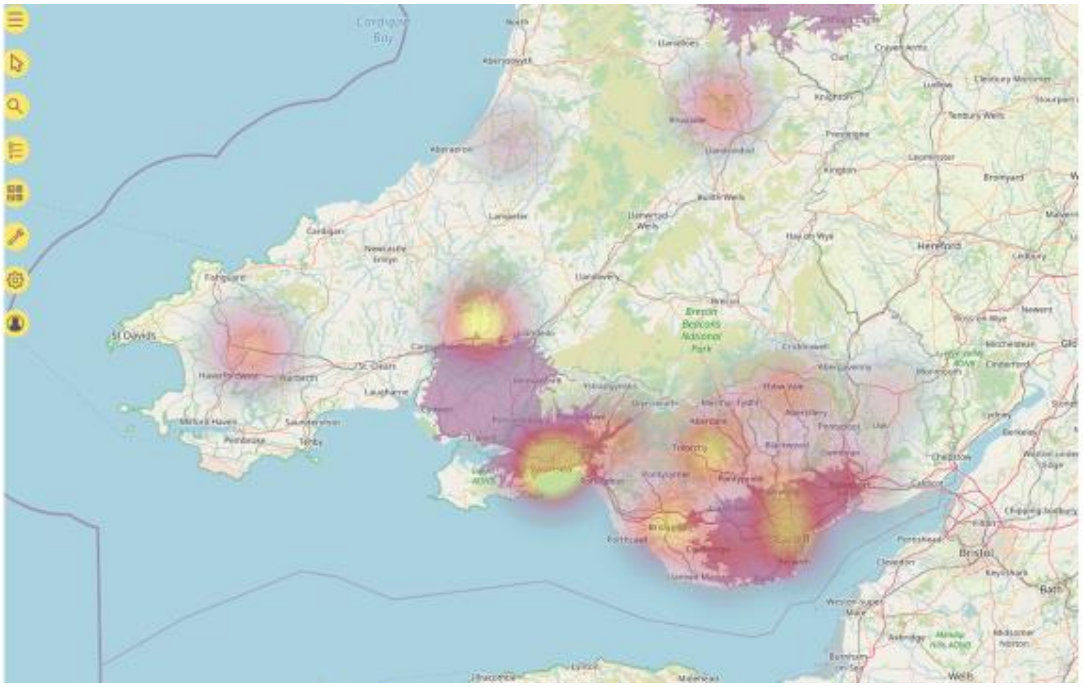


Figure 4 predicted physician requirement activity heatmap

In order to support the question of where physician-led interventions are required and the optimal location of the physician-led team, the number of cases which require a physician have been plotted in Figure 4, and also tabulated in Figure 5.

Physician required	Region				
Locality	**N**	**OOA**	**SE**	**SW**	**Grand Total**
Blaenau Gwent			13		13
Bridgend			25		25
Caerphilly			18		18
Cardiff			24		24
Carmarthenshire				29	29
Ceredigion				7	7
Conwy	<5				<5
Denbighshire	25				25
Flintshire	6				6
Gwynedd	38				38
Isle Of Anglesey	<5				<5
Merthyr Tydfil			<5		<5
Monmouthshire				7	7
Neath Port Talbot				17	17
Newport			15		15
Out of Area		13			13
Pembrokeshire				19	19
Powys				18	18

Rhondda Cynon Taff			23		23
Swansea				41	41
Torfaen			<5		<5
Vale Of Glamorgan			14		14
Wrexham	22				22
Grand Total	**94**	**13**	**139**	**138**	**384**

Figure 5 requirement for physician-led cases estimate by locality

The two options that involve service reconfiguration were modelled for impact using service and WAST data. Potential impacts are presented in Figure 6 below.

Option	Configuration	Impact
Enhances HEMS service #2	**Cardiff:** Doctor, CCP 24/7, x 1 pilot **Dafen:** CCP, HTP and x1 Pilot (12 hour-days)	**805 additional calls attended per year (pan- Wales)** **129 require a physician present on scene** **SW region gains additional 249 cases per year** **SW requires physician backup on scene between 50 – 127 cases per year (double task)** **SE region gains 497 cases per year** **N region up to additional 59 cases per year through reduced cross cover (9 physician)**
Enhanced HEMS service #3	**Cardiff:** CCP, HTP and x1 Pilots (12 hour-days); Doctor, CCP and x2 Pilots 12 hour (12 hour-nights) **Dafen:** Doctor, CCP and x1 Pilot (12 hour-days)	**805 additional calls attended per year (pan- Wales)** **129 require a physician present on scene** **SW region gains additional 249 cases per year** **SE requires physician backup on scene between 54-139 cases per year (double task)** **SE region gains 497 cases per year** **N region up to additional 59 cases per year through reduced cross cover (9 physician)**

Figure 6 Impact of configurations

Recommendation

The analysis undertaken (above) suggests that an enhanced service offering an additional HEMS response would provide significant improvements in terms of aircraft utilisation, service delivery and patient outcomes as follows:

Physician-led service 24/7
Enhanced level of care and increased range of critical care interventions across current and unmet need
An increased use of the H145 for HEMS offers greater endurance / capacity
More effective utilisation of staff skills and assets
Aligned with Charity's purpose to relieve illness and injury and the mission to protect human life
Involves HTPs developing to become HEMS staff - aligned with clinical and skills sustainability investment objective
Continues to support thrombectomy/STEMI transfers
Better integration for H67 with EMRTS case mix
Opportunity to support pilot training and increased operational availability
Potential increased PHEM phase 2 opportunities
Reduces double dispatch (HTP-led response requires back-up by H57 by air)
Consistency of HEMS service (24/7, familiarity of kit, aircraft etc)
Potentially better utilisation of 145 aircraft, increased value for money
Reduction in stand-downs for SE area (closer proximity, WAST wait rather than leave scene)
CCP-led HEMS team able to support STEMI (heart attack) transfers between Bronglais and Morriston
Provides the opportunity to increase the HEMS asset in the hours of darkness (145)
Increased endurance due to use of 145 aircraft for transfers (day)
Use of most appropriate platform for air transfers
Able to support West Wales (ACCTS and SWMTN)

Double pilot model by day allows WATCh jobs and future-proofs neonatal taskings

In summary, the improvements listed above will be realised within the key investment objectives below.

- **value for money** - in terms of more effective utilisation of both the clinical skills and the response options available
- **health gain -** offering enhanced levels of care, an increased range of critical care interventions and ensuring dual EMRTS practitioner response
- **equity -** ensuring the availability of appropriate critical care skills and the required critical care interventions
- **clinical and skills sustainability** - as well as offering development opportunities for existing HTP staff, this will offer an improved HEMS response model experience

However, the data does not identify the optimal strategic location of the physician-led resource as part of the 'enhanced HEMS service' options.

For this reason, it is recommended that a 12-month evaluation period using the principles of Plan, Do, Study, Act (PDSA) is undertaken, see Appendix 1. The service model that is proposed for the duration of the study is included as Appendix 2, this will allow exploration of both of the enhanced HEMS service options.

The study will involve the use of the existing workforce on the basis of overtime and it is estimated that this will provide a 3-4 day service per week. The cost is estimated at £100k p.a. (Full Year Effect)[6].

The figures relating to predicted activity pertain to an established 7-day service over a 12-month period. For the purposes of this study, it is expected that there will be seasonable variability and that activity will be reduced accordingly to reflect the proposed 3-4 day service.

[6] This was subsequently resourced 7 days per week through substantive posts, not using overtime. It will be reviewed post 12 months of operation (March 2023).

In terms of increased aircraft utilisation, it is expected that the enhanced HEMS service would increase flights of H67 by an average of 1 per day taking into account the 20-minute emergency drive time around Cardiff heliport and activity.

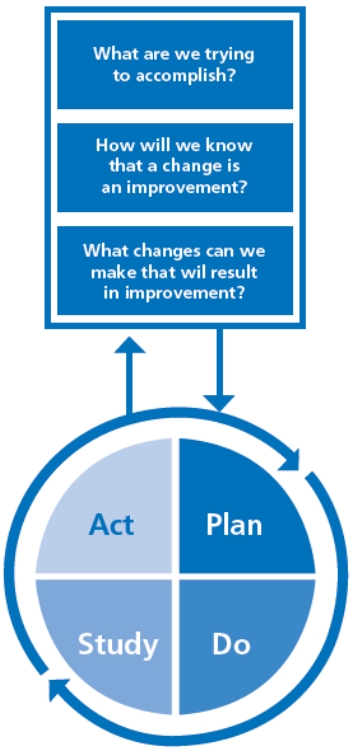
This approach will test the assumptions made (above) including to:

- test and supplement the data analysis undertaken
- measure and differentiate the impact of both of the enhanced HEMS service options
- identify any impact on the activity of other bases

An evaluation report will then be prepared that allows an informed decision to be made regarding the implementation of one of the options as part of the long-term strategy to optimise value for money and ensure the most effective service configuration.

The paediatric WATCH transfers require two pilots even though transfers are usually in daylight to and from designated helipads. The numbers of transfers are very small (6-8 per annum). If we accepted that these transfers were done by ground or other services then a single pilot daytime operation could be considered – delivering financial savings to the Charity.

Appendix 1: PDSA Model



Appendix 2: Proposed enhanced service model

For illustration purposes, the enhanced service that would be evaluated over this period, is illustrated in the table below:

Base	Configuration	Operating Hours	Configuration	Operating Hours
	EXISTING		**PROPOSED**	
Cardiff	AA/Transfer aircraft HTP, x1 Pilots HEMS air and road response	0700-1900 1900-0700	**HEMS air and road response** **CCP and HTP, x2 Pilots** HEMS air and road response	0700-1900 1900-0700

	Consultant & CCP, x2 Pilots		Consultant & CCP, x2 Pilots		
Caernarfon	HEMS air and road response Consultant & CCP or Double CCP, x1 Pilot	0800-2000	HEMS air and road response Consultant & CCP or Double CCP, x1 Pilot	0800-2000	
Dafen	HEMS air and road Consultant & CCP, x1 Pilot	0700-1900	HEMS air and road Consultant & CCP x1 Pilot	0700-1900	
Welshpool	HEMS air and road Consultant & CCP or Double CCP, x1 Pilot	0800-2000	HEMS air and road Consultant & CCP or Double CCP, x1 Pilot	0800-2000	

In addition to the existing EMRTS service model illustrated above, the service will continue to be co-ordinated by the EMRTS Critical Care Hub with support and advice from the Top Cover Consultant on a 24-hour basis.

4 Appendix C Longitudinal review (2010 -2020)

Data from the Welsh Ambulance Services control systems was analysed to look at the activity of the bases both by air, and road when introduced formally in 2015 (South and Mid Wales) and 2017 (North Wales). The period covers a number of changes outlined elsewhere in this document, but include base moves, road vehicle introductions and changes in aircraft types. Significant variations in weather patterns are also covered. The dispatch criteria of the service, in line with international changes are also reflected, and taken into account, as well as changes to the wider NHS in Wales such as changes to clinical flows (e.g. trauma networks, cardiac networks, and stroke treatment). Whilst not relevant to any metrics used by the service, it should also be noted that there was a change in ambulance response model during the period. The review also included dispatch criteria, governance process, and missed tasking for the latter years.

Ambulance data has been summarised to cover the period 2010 – 2020. This data should be treated with caution, and stand alone to illustrate trends.

The following points should be noted

1. RRV not routinely available, or using a dedicated call sign pre-April 2015 (Swansea, Welshpool) or July 2017 (Caernarfon).
2. In 2013 and 2014, two PDSA cycles were completed by WAST, to examine whether a dedicated air support desk would be beneficial. Because of these, the single dispatcher ASD was introduced in North Wales. This latterly was superseded by a clinician & dispatcher desk in South East Wales as part of the EMRTS service specification in April 2015.
3. The ambulance service response model, control system and methods of coding calls have changed multiple times during this period. This affects the “counts” and “stand downs”.
4. There have been Health Board boundary changes during this time.

It is beyond the remit and resource of this analysis to drill down into historical data pre- 2015, but it is included for context.

In addition, data presented previously, relating to individual base activity is included in Appendix B Base review.

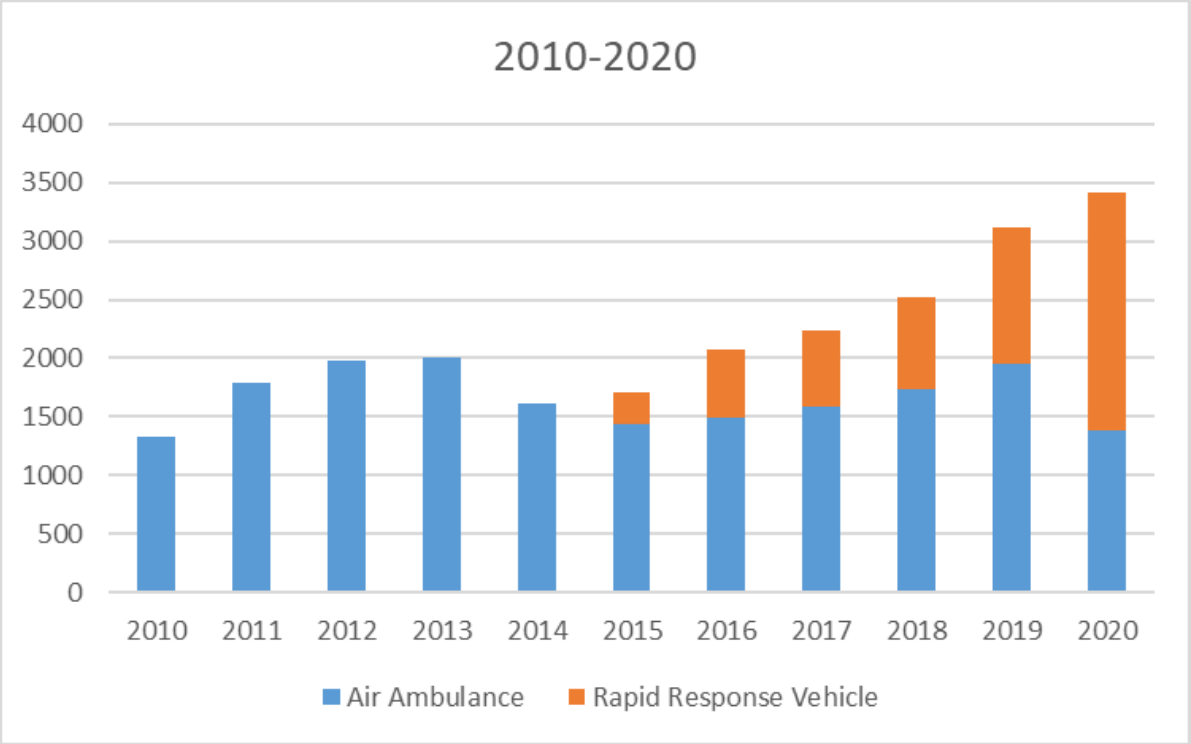


Figure 1 Graph of 10-year activity (nb. This includes stand downs, which vary throughout the period)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Air Ambulance	**1332**	**1785**	**1985**	**2008**	**1618**	**1438**	**1486**	**1586**	**1730**	**1957**	**1384**
WAA Caernarfon (North)	399	621	659	660	523	383	350	399	405	455	303
WAA Cardiff (South East)								20	164	152	89
WAA Dafen (South)							357	688	677	799	624
WAA Swansea airport	625	745	818	717	636	625	300				
WAA Welshpool (Mid-Wales	308	419	508	631	459	430	479	479	484	551	368
Rapid Response Vehicle						**270**	**591**	**657**	**788**	**1161**	**2030**
WAA Caernarfon (North)								39	86	116	89
WAA Cardiff (South East)								2	214	407	1316
WAA Dafen (South)							294	537	407	513	517
WAA Swansea airport						219	205				
WAA Welshpool (Mid-Wales)						51	92	79	81	125	108
Grand Total	**1332**	**1785**	**1985**	**2008**	**1618**	**1708**	**2077**	**2243**	**2518**	**3118**	**3414**

Figure 2 10-year call data by response mode

4.1.1.1 Dispatch criteria

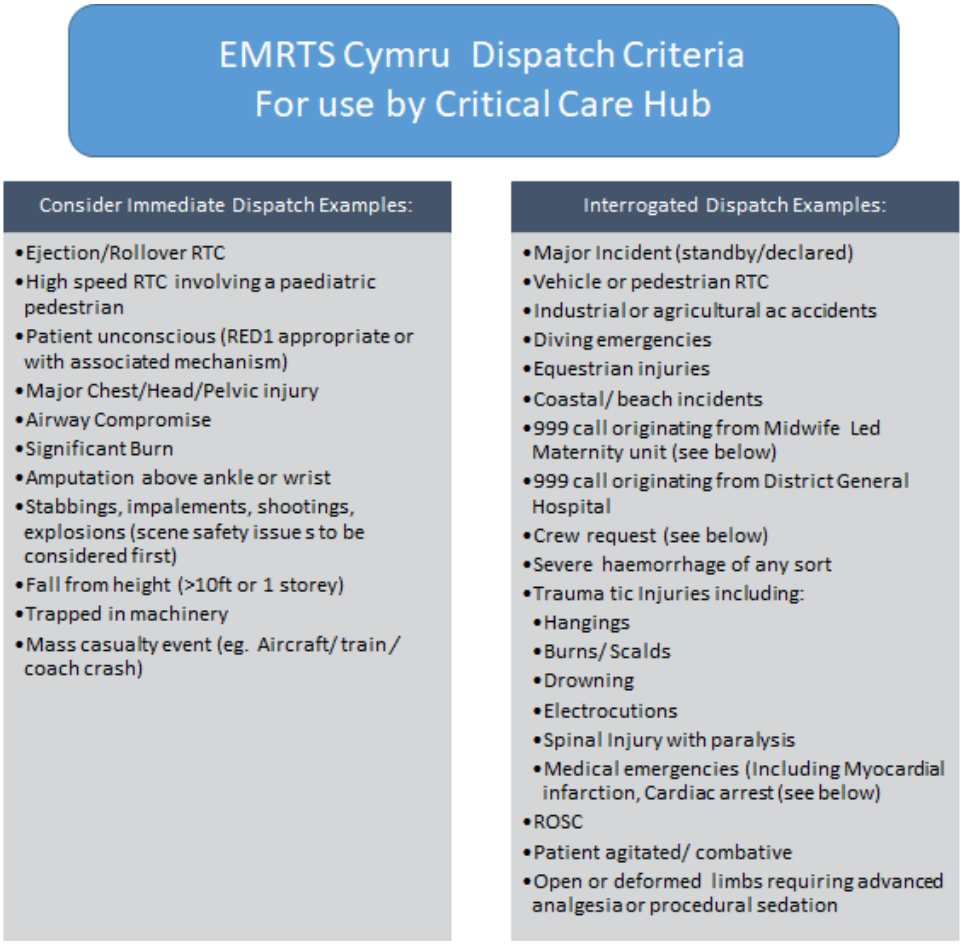
The Critical Care Hub (CCH, formerly Air Support Desk/ ASD) allocates resources according to standard operating procedures, prioritised on clinical need and timeliness to definitive care. The decision to use an aircraft, or RRV is made by the duty team taking into account weather, time of day, location of the incident (including accessibility) and balancing the timeliness of attendance. The primary aim is to get the clinical team to the patient safely and in a timely manner. The criteria hasn't changed materially since 2015, although minor changes in wording have taken place recently including an update to the wording around access issues.

The mission statement adhered to is

"To provide advanced decision making & critical care for life or limb threatening emergencies that require transfer for time-critical specialist treatment at an appropriate facility"

Complimenting this, regulations relating to air response state "It is for the medical professional to decide between HEMS or air ambulance[7]" taking into account "life and death (or consequential injury of ground transport)". Analogies between blue light and siren response versus normal road speed response are made.

[7]AMC/GM TO ANNEX V (PART-SPA), Subpart J- HEMS
https://www.easa.europa.eu/sites/default/files/dfu/Consolidated%20unofficial%20AMC&GM_Annex%20V%20Part-SPA.pdf



Notes;

Access Issues: The primary role of the EMRTS critical care team is to provide enhanced medical care in serious time-critical cases.

In the event a request to provide air support is made in the non-time critical situation i.e. remote location or protracted road transfer. These missions should only be undertaken when no other appropriate resource is available (including HART, SAR & Mountain Rescue), and only with the agreement of the Top Cover Consultant.

Major Trauma

In addition to internal guidance, the service operates within the area served by two major trauma networks, North West Midlands and North Wales MTN, and South Wales Major Trauma Network. Both networks have trauma triage tools, shown in appendix 2 & 3. The service has some discretion around adherence to the tools, but largely acts in accordance with them from the perspective of transporting patients to a Major Trauma Centre when required. In addition for South Wales, the ECCH

provides advice to WAST crews overnight in relation to the trauma tool, within its "trauma desk" function.

4.1.1.2 Decision making & case review

Figure 3 illustrates an average day on the CC Hub, in terms of numbers of calls reviewed, and the resultant response during a 24-hour period for 999 calls. In addition, direct calls from hospital are made for transfers.

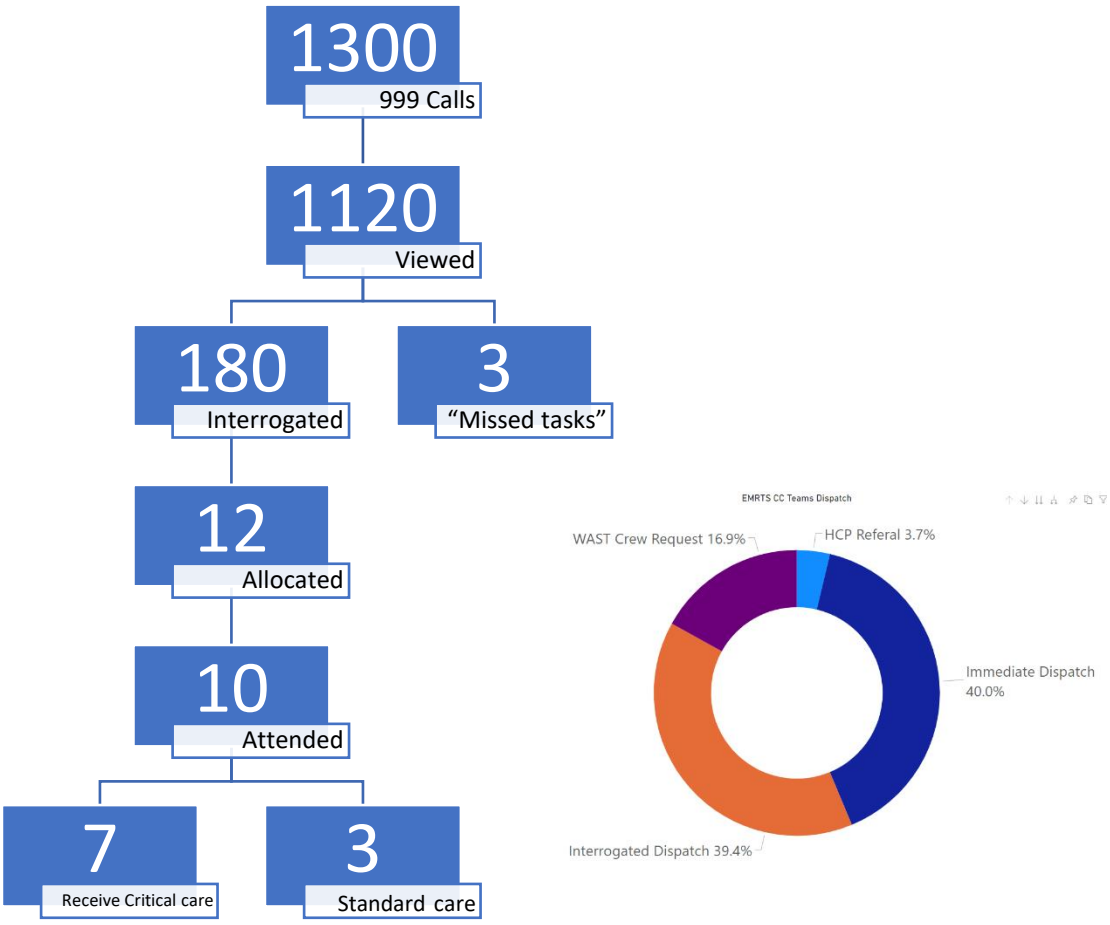


Figure 3 Typical Day[8]

The service continuously reviews cases on a daily basis, as well as conducts a number of regular clinical audits and case reviews. An overview of these processes are included below;

[8] 2020 average

- Daily reviews (flagging cases for review at various groups)
    - Administrator
    - Patient Liaison Nurse
    - Top Cover Consultant
- Scheduled review meetings
    - Top cover conference (Quarterly)
    - Governance Day (Monthly)
    - Mortality & Morbidity (Quarterly)
- Board Sub-groups reviewing cases:
    - Equipment
    - Transfer & Retrieval
    - Research & Audit
    - Medicines Management (PGD, Procedural sedation)
    - Education & Engagement
    - Airway (Anaesthesia audit)
    - Blood
    - Mass Casualty/Major Incident
    - Critical Care Hub (inc. review of missed tasking)
    - Top Cover reviews
- External
    - Clinical Advisory Panel (Inc. Paediatric/ neonatal cases)
    - Trauma networks (NWM&NM, SWTN)
    - Critical Care network (all CC Transfers)
    - CHANTS

4.1.1.3 Missed tasking

The EMRTS Critical Care Hub routinely records “missed Tasking” entries against any ambulance incident that they would have ordinarily considered tasking a resource. This includes clinical interrogation (of notes, people on scene or listening to the 999 call). In the last 12 months alone this includes 1060 such incidents, with only 50 being marked as “not required”. Data can be stratified by time of day, date, geography, call type, and reason for being “missed”.

Once data is cleansed to remove the not required group, and cases where there was no operational night aircraft, 977 cases remain. These have been summarised by Health Board, time of day and reason recorded.

	Already committed	Offline	Perceived time delay	Weather	Grand Total
Aneurin Bevan University Health Board					
Day	62	<5	<5	<5	73
Night	78	<5	<5		85
Betsi Cadwaladr University Health Board					
Day	31	6	16	7	60
Night	31	67	48	9	155
Cardiff and Vale University Health Board					
Day	62		5		67
Night	91				91
Cwm Taf Morgannwg University Health Board					
Day	59	<5	<5	<5	66
Night	76	<5			78
Hywel Dda University Health Board					
Day	39		<5	6	47
Night	42	<5	12	<5	62
Powys Teaching Health Board					
Day	6		<5	<5	12
Night	8	8	8	7	31
Swansea Bay University Health Board					
Day	71	6	<5	<5	80
Night	64	<5	<5		70
Grand Total	**720**	**104**	**112**	**41**	**977**

4.1.1.4 Day

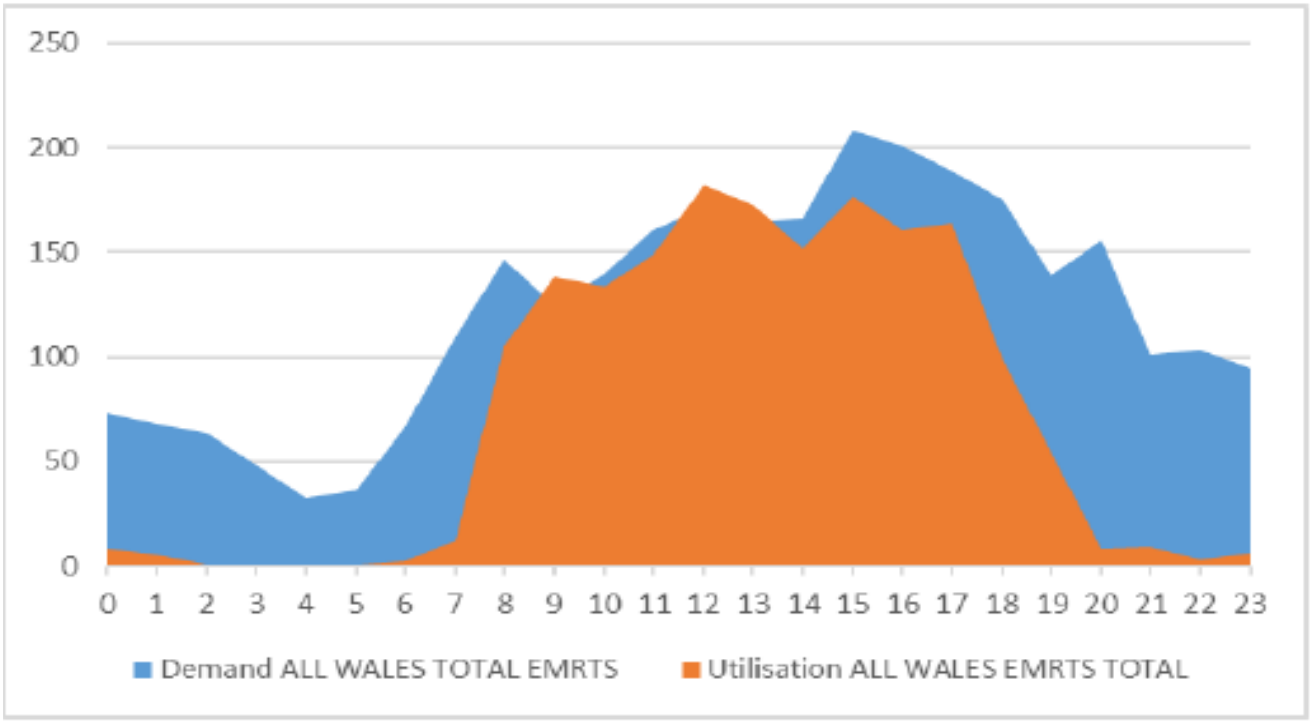
During the day, the majority (n= 293, 89%) of missed tasks occur across south Wales health boards with the remainder in north Wales & Powys (n=37). This makes a strong case for increasing the presence of the service across south Wales during these hours with multiple teams available to respond to calls concurrently. With teams geographically spread (i.e., Dafen and Cardiff) this also ensures that if the weather is not favourable, a road response can be made in a timely manner.

4.1.1.5 Night

Whilst the single largest count of missed tasks occurs in North Wales (BCUHB), the majority of missed tasks still occur across the South Wales area. Up to a third of missed cases in North Wales occur before 22:00 and could be served by extended or staggered hours. More analysis would be required to look at the seasonal variation in such cases.

4.1.1.6 Activity predictions

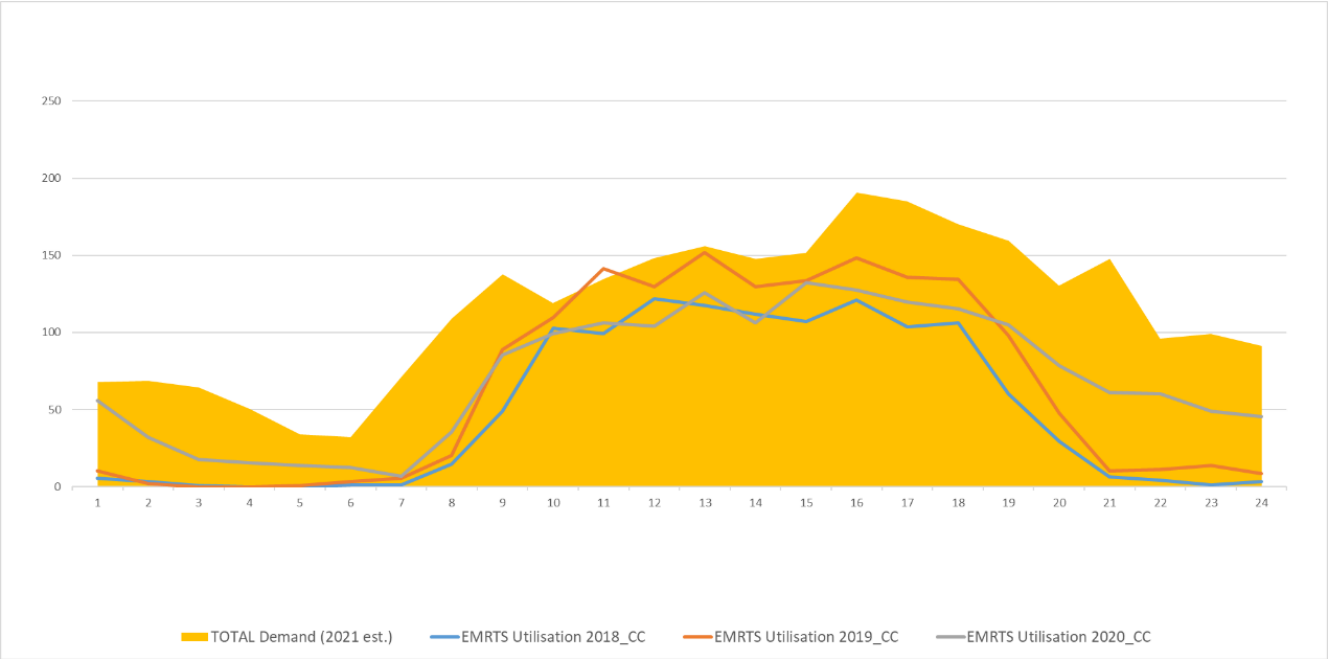
As presented to the aviation subgroup, the activity predictions are revised here. During the 2018 service expansion review, it was revealed that there were 991 cases per year of "unmet need" between the hours of 20:00-08:00. Activity was analysed in the context of overall demand, and a plan made to meet the gap through a phased expansion of the EMRTS staffing and infrastructure.



Within the constraints posed by the impact of the pandemic, data was analysed from service records, Welsh Ambulance Service records and other NHS Wales datasets. Data from parts of 2020 and early 2021 were also used covering a full 24-hour period, and missed task data was also used to refine the model. A conservative estimate reveals that activity is expected to rise by 22% over the next five years. The new demand has been plotted below. For context the utilisation for 2018, 2019 and 2020 is also plotted revealing unmet need.

When calculating the 22% uplift we considered various factors including the general increase in activity that is observed once a new base is established, and the resource availability becomes established. This takes into account a period of engagement with stakeholders required to ensure that they utilise the service e.g. WAST staff, and hospital staff. We have observed increases in activity ranging from 16% to 39% when individual bases and their location are considered (Dafen, Caernarfon, and Cardiff). This includes the additional opportunity afforded by ease of access to the road network in Dafen and Cardiff. 39% is based on a period where we were operating a road-based twilight service from Cardiff, with a reduced coordination function (a non-clinical desk) where the threshold was relatively lower for activation. 22% covered a scenario where there was an established Cardiff service (i.e. both scenarios being reviewed), and 16% was based on activity increases witnessed in Dafen. Consideration has also been given to increased requirement to support changes in flows relating to the provision of specialist care e.g. Cardiac arrest, Stroke, Major Trauma as those services and plans are enacted.

These either require increased attendance at 999 calls, or require additional secondary transfers due to automatic acceptance policies. Missed Task data has also been considered. As a frame of reference, overall 999 ambulance workload was increasing by 3.4% per year in Wales prior to the pandemic, and so if only taking this data in isolation we would expect to observe an increase of 20.4%.



The modelling data covers a 24-hour period, and is categorised by Health Board. It does not currently take into account seasonal variation. Whilst this data is of interest, it is not relevant to the planning of the clinical workforce for whom it would be very difficult to step up and step down for varying base shifts (timing and location). Where relevant such data has been analysed to answer specific questions such as how to best use winter pressures funding, or looking at staggered shift times.

5 Appendix D Base review

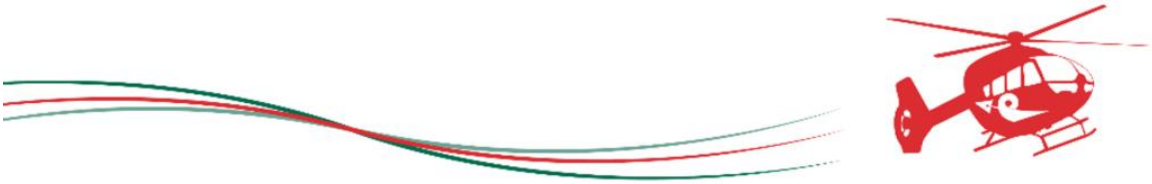
Dafen Base

Historical Activity (18-20)

- 1356 Cases per year
- 62% Air
- 38% Road
- 19.6% Air Stand Down rate

Planning data

- 1554 cases per year estimated
- Road population coverage
  - 30 Mins : 19%
  - 60 Mins: 67%
  - 90 Mins: 76%



LHB	Air Ambulance (H57)	Total
Abertawe Bro	**192**	**192**
Bridgend	50	50
Neath Port Talbot	62	62
Swansea	80	80
Aneurin Bevan	**445**	**445**
Blaenau Gwent	52	52
Caerphilly	160	160
Monmouthshire	97	97
Newport	83	83
Torfaen	53	53
Betsi Cadwaladr	**19**	**19**
Denbighshire	4	4
Flintshire	2	2
Gwynedd	9	9
Isle Of Anglesey	3	3
Wrexham	1	1
Cardiff and Vale	**263**	**263**
Cardiff	149	149
Vale Of Glamorgan	114	114
Cwm Taf	**87**	**87**
Merthyr Tydfil	16	16
Rhondda Cynon Taff	71	71
Cwm Taf Morgannwg	**231**	**231**
Bridgend	68	68
Merthyr Tydfil	46	46
Rhondda Cynon Taff	117	117
Hywel Dda	**530**	**530**
Carmarthenshire	224	224
Ceredigion	109	109
Pembrokeshire	197	197
Out of Area	**7**	**7**
Out of Area	7	7
Powys	**92**	**92**
Powys	92	92
Swansea Bay	**238**	**238**
Neath Port Talbot	105	105
Swansea	133	133
Total	**2104**	**2104**

EMRTS Cymru

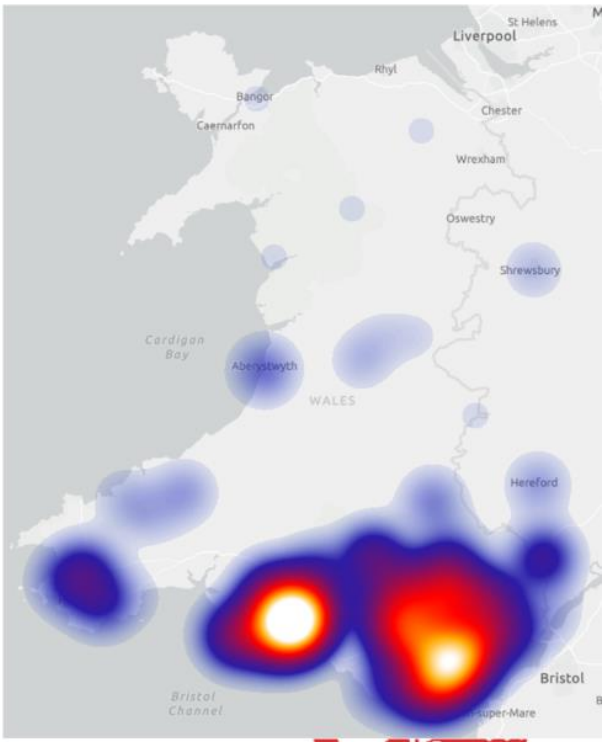
WAACT Operational Report

Reporting Nature	Count of WAA count
Animal related injuries	15
Breathing Problems	73
Burns or Explosions	41
Cardiac Arrest	453
Cardiac related	26
Drowning	21
Falls	251
Other Medical	43
Other Trauma	327
Penetrating Trauma	62
Pregnancy or Childbirth Related	15
Road Incidents	421
Seizures	80
Stroke	11
Transfer	128
Unconscious	137
Total	**2104**

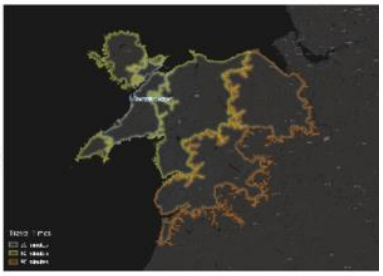
IncidentDate

01/01/2018 31/12/2020

Dafen



Caernarfon Base



Historical Activity (18-20)

- 567 Cases per year
- 80% Air
- 20% Road
- 13.7% Air Stand Down rate

Planning data

- 666 cases per year estimated
- Road population coverage
  - 30 Mins : 3%
  - 60 Mins: 11%
  - 90 Mins: 24%

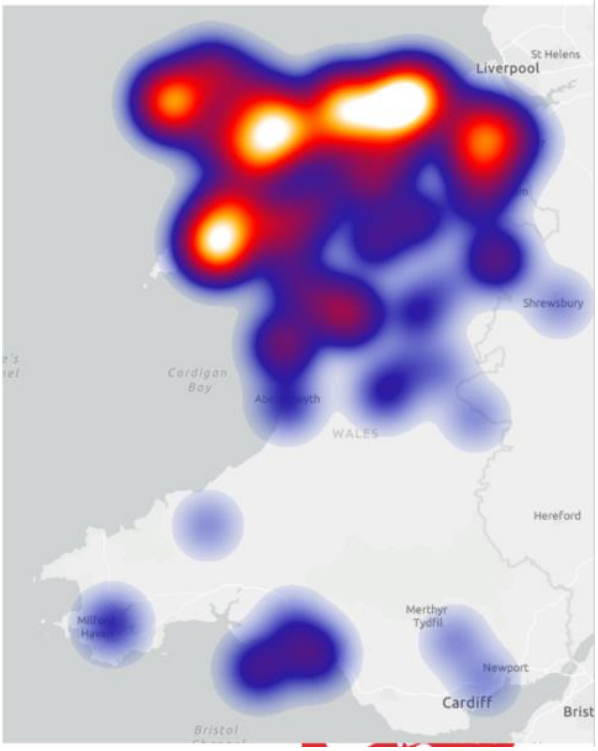
LHB	Air Ambulance (H61)	Total
Aneurin Bevan	**2**	**2**
Caerphilly	1	1
Torfaen	1	1
Betsi Cadwaladr	**1066**	**1066**
Conwy	195	195
Denbighshire	131	131
Flintshire	73	73
Gwynedd	422	422
Isle Of Anglesey	205	205
Wrexham	40	40
Cardiff and Vale	**1**	**1**
Cardiff	1	1
Cwm Taf	**2**	**2**
Merthyr Tydfil	1	1
Rhondda Cynon Taff	1	1
Cwm Taf	**2**	**2**
Bridgend	1	1
Rhondda Cynon Taff	1	1
Hywel Dda	**45**	**45**
Carmarthenshire	8	8
Ceredigion	27	27
Pembrokeshire	10	10
Out of Area	**2**	**2**
Out of Area	2	2
Powys	**58**	**58**
Powys	58	58
Swansea Bay	**3**	**3**
Neath Port Talbot	1	1
Swansea	2	2
Total	**1181**	**1181**

WAACT Operational Report

Reporting Nature	Count of WAA count
Animal related injuries	12
Breathing Problems	73
Burns or Explosions	21
Cardiac Arrest	203
Cardiac related	58
Drowning	11
Falls	138
Other Medical	28
Other Trauma	194
Penetrating Trauma	25
Pregnancy or Childbirth Related	2
Road Incidents	199
Seizures	30
Stroke	7
Transfer	126
Unconscious	54
Total	**1181**

IncidentDate

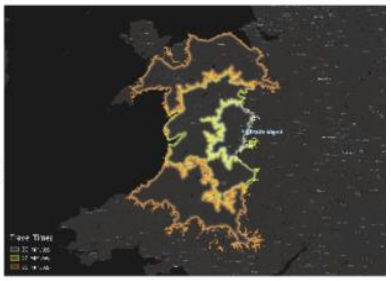
02/01/2018 30/12/2020



Caernarfon

EMRTS Cymru
Emergency Medical Retrieval & Transfer Service

Welshpool Base



Historical Activity (18-20)

- 649 Cases per year
- 82% Air
- 18% Road
- 20.9% Air Stand Down rate

Planning data

- 786 cases per year estimated
- Road population coverage
  - 30 Mins : 2%
  - 60 Mins: 5%
  - 90 Mins: 28%

LHB	Air Ambulance (HS9)	Total
Abertawe Bro	**6**	**6**
Bridgend	2	2
Neath Port Talbot	1	1
Swansea	3	3
Aneurin Bevan	**73**	**73**
Blaenau Gwent	9	9
Caerphilly	16	16
Monmouthshire	30	30
Newport	7	7
Torfaen	11	11
Betsi Cadwaladr	**598**	**598**
Conwy	51	51
Denbighshire	124	124
Flintshire	136	136
Gwynedd	111	111
Isle Of Anglesey	23	23
Wrexham	153	153
Cardiff and Vale	**11**	**11**
Cardiff	7	7
Vale Of Glamorgan	4	4
Cwm Taf	**12**	**12**
Merthyr Tydfil	2	2
Rhondda Cynon Taff	10	10
Cwm Taf Morgannwg	**41**	**41**
Merthyr Tydfil	7	7
Rhondda Cynon Taff	34	34
Hywel Dda	**147**	**147**
Carmarthenshire	44	44
Ceredigion	67	67
Pembrokeshire	36	36
Out of Area	**45**	**45**
Out of Area	45	45
Powys	**419**	**419**
Powys	419	419
Swansea Bay	**33**	**33**
Neath Port Talbot	17	17
Swansea	16	16
Total	**1385**	**1385**

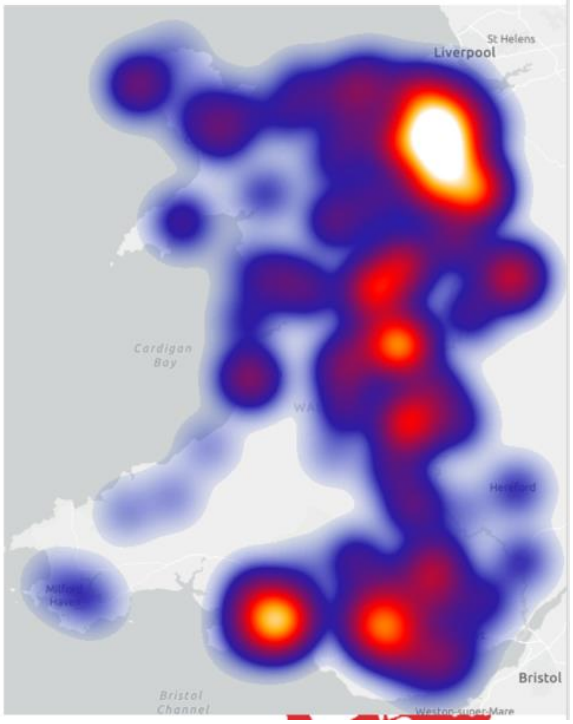
EMRTS Cymru
Emergency Medical Retrieval & Transfer Service

WAACT Operational Report

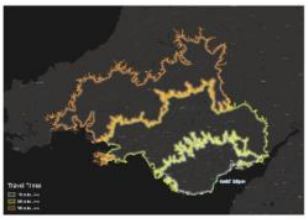
Reporting Nature	Count of WAA count
Animal related injuries	13
Breathing Problems	54
Burns or Explosions	36
Cardiac Arrest	197
Cardiac related	52
Drowning	15
Falls	134
Other Medical	22
Other Trauma	281
Penetrating Trauma	23
Pregnancy or Childbirth Related	6
Road Incidents	315
Seizures	43
Stroke	10
Transfer	104
Unconscious	80
Total	**1385**

IncidentDate
01/01/2018 31/12/2020

Welshpool



Cardiff Base



Historical Activity (18-20)

- Air
  - **377** Transfer Cases
  - 24 Primary Responses
- Road
  - **1945** Primary responses
    - 48% of RRV activity for whole period
  - **1322** during 2020
    - 65% of RRV activity

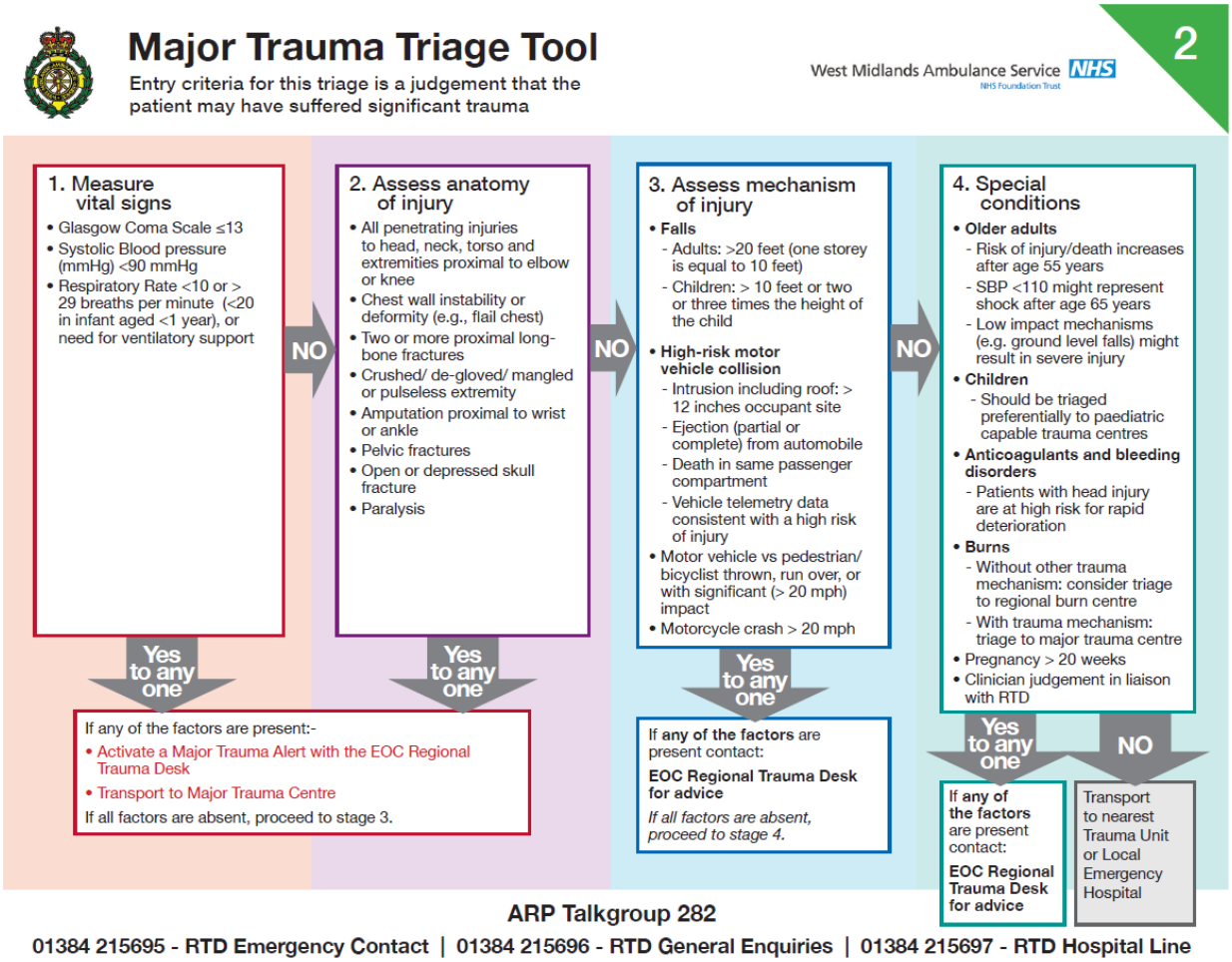
Planning data

- 1788 cases per year estimated
- Road population coverage
  - 30 Mins :39%
  - 60 Mins:65%
  - 90 Mins: 69%

9

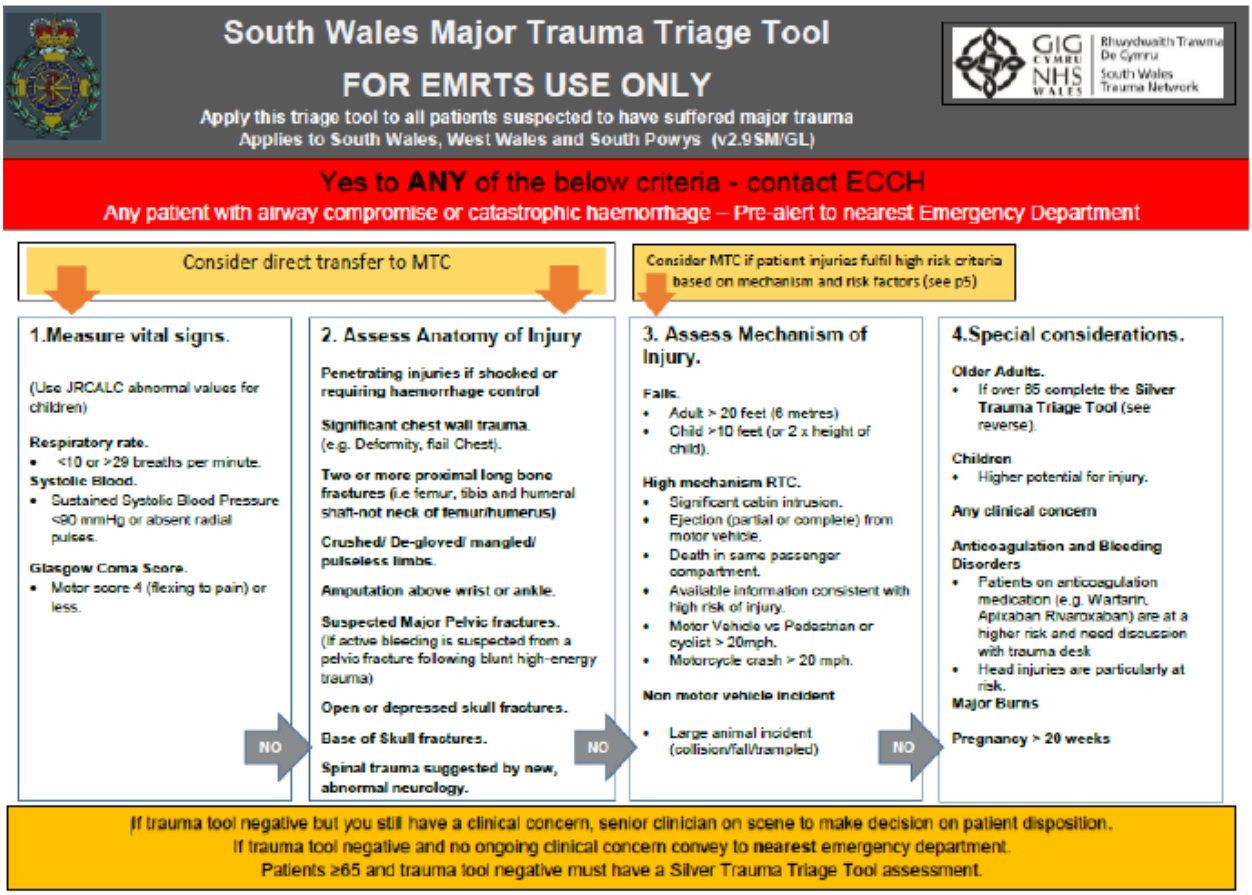
[9] including various twilight RRV initiatives

6 Appendix E WMAS Trauma Triage Tool (NWM&NM MTN)



7 Appendix F SWTN Trauma Triage Tool

Trauma Triage Tool Patient Disposition AND Primary/Secondary Transfer - EMRTS

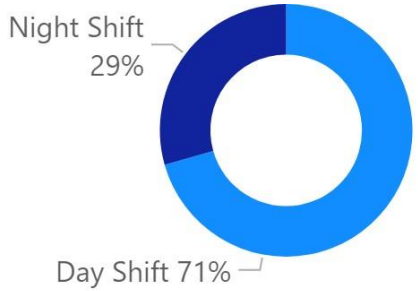


8 Appendix G Regional Demand profile

The following pages contain the demand profile and unmet need from work package 2

Betsi Cadwaladr

Current Demand

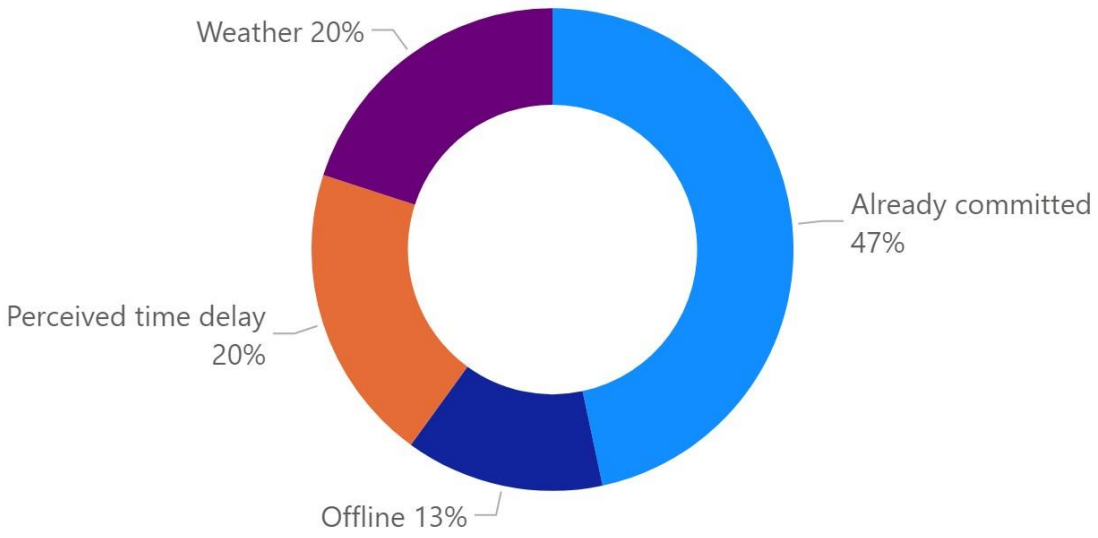


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1		1	4	1	4		2	1	4	3	1	**22**
1	1	4		2	1	5	2	3	4	3	3	2	**30**
2	1	1				1		2		1	1		**7**
3	1			1	3		2	1		1	2	1	**12**
4	1				2	2		2		2		1	**10**
5	2	1	1	1			2	1	2	1		1	**12**
6	3		2		1		1	2	2		2		**13**
7	4	4	2	1	3	3	3	3	1	2			**26**
8	5	3	3	2	8	2	4	4	5	2	2	1	**41**
9	3	1	4	4	6	1	7	2	3	4	4	7	**46**
10	4	3	2	7	3	2	5	5	6	7	2	7	**53**
11	6	5	3	4	4	5	3	6	9	2	5	2	**54**
12	1	2	7	7	6	11	10	6	9	6	4	4	**73**
13	4	3	3	5	3	4	7	10	4	8	10	4	**65**
14	5	3	4	9	8	9	7	14	5	5	5	5	**79**
15	6	3	1	7	5	8	9	7	7	8	9	7	**77**
16	5	2	5	7	10	7	7	1	12	6	8	6	**76**
17	3	4	1	3	8	10	6	4	3	7	3	10	**62**
18	4	4	5	5	6	4	6	2	5	4	2	2	**49**
19	2	4	1	2	8	6	4	3	1	4	1	2	**38**
20	2	1	5	4	4	4	4	8	5	1	2	2	**42**
21	2	2	2	3	3	5	4	6	5	5	4	3	**44**
22		1	2	5		2	2	5	4	2	2	3	**28**
23	1	5	1	4	3	2	4	5	1	1	1	4	**32**
Total	**67**	**56**	**55**	**87**	**96**	**97**	**99**	**104**	**94**	**86**	**75**	**75**	**991**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	50	37	40	61	70	66	74	64	69	61	54	55	**701**
⊞ Night Shift	17	19	15	26	26	31	25	40	25	25	21	20	**290**
Total	**67**	**56**	**55**	**87**	**96**	**97**	**99**	**104**	**94**	**86**	**75**	**75**	**991**

Missed Task Breakdown

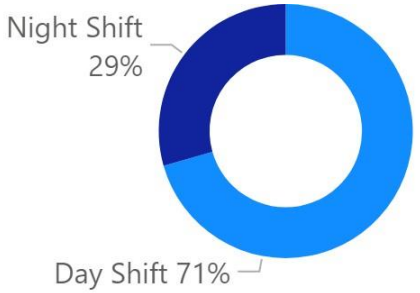


665
Attended

Betsi Cadwaladr Umet need

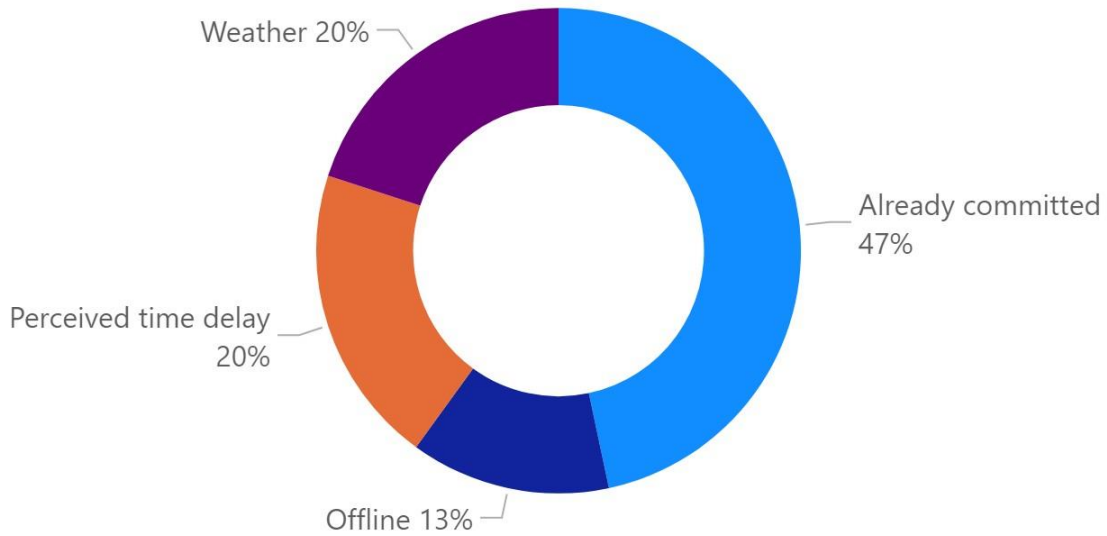
Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1		1	3	1	4		2	1	4	3	1	**21**
1	1	4		2	1	5	1	3	4	2	2	2	**27**
2		1				1		2		1	1		**6**
3	1			1	3		1	1		1	2	1	**11**
4	1				2	2		2		2		1	**10**
5	2	1	1	1			2	1	2	1		1	**12**
6	2		1		1		1	2	2		2		**11**
7	3	3	1	1	1	2	3	1		1			**16**
8						1		1					**2**
9			1			1	1					1	**4**
10									1			1	**2**
11				2		2		2	1				**7**
12			1	1			1		2				**5**
13					1			1	1				**3**
14				2		2	1	2	1				**8**
15	3	1		1					3	1		1	**10**
16	2				2	1	1		2	1		2	**11**
17	1	1		1	2	3			1	1		3	**13**
18				1		1	3	1		1			**7**
19		2			2	2	1			4		2	**13**
20	2		4	4	4	2	3	6	4	1	2	1	**33**
21	2	2	1	2	2	5	4	4	5	3	4	3	**37**
22		1	2	5		2	2	5	4	2	2	2	**27**
23	1	5	1	3	3	2	4	4	1	1	1	4	**30**
Total	**22**	**21**	**14**	**30**	**25**	**38**	**29**	**40**	**35**	**27**	**19**	**26**	**326**
Total	**22**	**21**	**14**	**30**	**25**	**38**	**29**	**40**	**35**	**27**	**19**	**26**	**326**



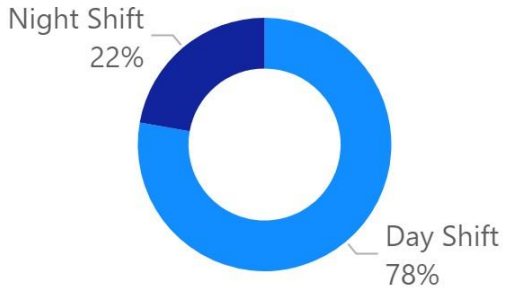
Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	9	5	3	9	6	13	10	8	12	5		8	**88**
⊞ Night Shift	13	16	11	21	19	25	19	32	23	22	19	18	**238**
Total	**22**	**21**	**14**	**30**	**25**	**38**	**29**	**40**	**35**	**27**	**19**	**26**	**326**

Missed Task Breakdown



665
Attended

Powys Current Demand

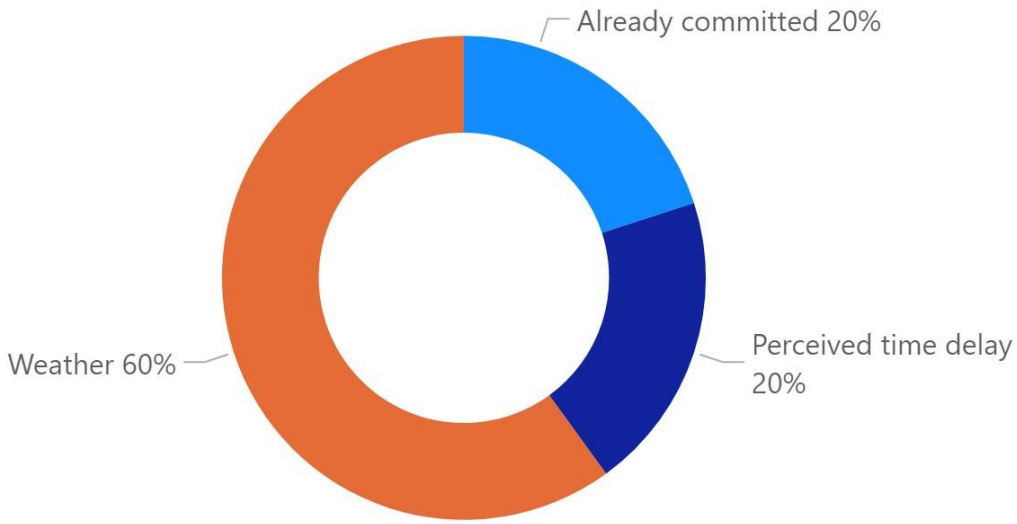


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1											**2**
1	2	1							2				**5**
2					2								**2**
3			1		1		1						**3**
4			1			1		1		1		1	**5**
5			1					1	1				**3**
6							1						**1**
7	1	3	1		1								**6**
8	2	1		2			1	1	2	1	1		**11**
9	5	2	1	2		4	2		1	3		1	**21**
10			1	1	4	2		1	3	1	2	1	**16**
11		2	2	3	1	2	4	2	4		4	1	**25**
12	1	1	1	2	2	1	2	2	3	2	1	2	**20**
13	3	1	1	2	3	1	1	3				1	**16**
14			1	4	2	3	2	2	3	2	1		**20**
15	1	2	1	3	1	3			4	6		1	**22**
16	1	1	2	2	2	4	1	2	3	1	1	2	**22**
17	2	1	3	1	1		1	1	2			1	**13**
18		1	1	1	2		3	2	4				**14**
19					1	1	2		3				**7**
20					1	3	2	1		1			**8**
21						1			1	1	2	1	**6**
22			1	2	1			3	1	1			**9**
23				1	1	2	1	1		1	1	1	**9**
Total	**19**	**17**	**19**	**26**	**26**	**28**	**24**	**23**	**37**	**21**	**13**	**13**	**266**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	16	15	15	23	19	20	17	16	29	16	10	10	**206**
⊞ Night Shift	3	2	4	3	7	8	7	7	8	5	3	3	**60**
Total	**19**	**17**	**19**	**26**	**26**	**28**	**24**	**23**	**37**	**21**	**13**	**13**	**266**

Missed Task Breakdown



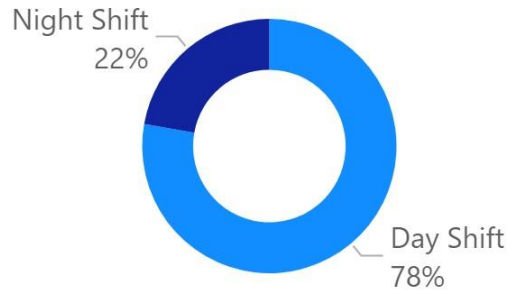
204
Attended

Powys

Umet need

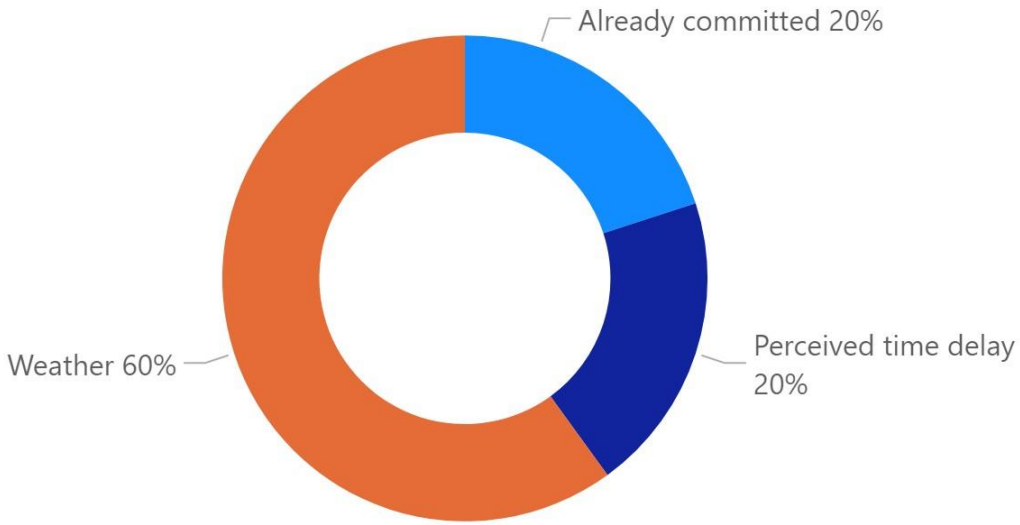
Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1											**2**
1	1	1							1				**3**
2					2								**2**
3			1		1		1						**3**
4										1		1	**2**
5			1					1					**2**
6							1						**1**
7	1	2											**3**
8								1					**1**
9	1						1						**2**
10									1				**1**
11											1		**1**
12					1				1				**2**
13						1		1					**2**
14				1				1	1				**3**
15						1							**1**
16						1					1		**2**
17	1	1										1	**3**
18					1				1				**2**
19							2		1				**3**
20						1	2	1					**4**
21						1					2		**3**
22			1	1	1			3	1				**7**
23				1		2	1	1		1		1	**7**
Total	**5**	**5**	**3**	**3**	**6**	**7**	**8**	**9**	**7**	**2**	**4**	**3**	**62**



Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	3	3		1	2	3	1	3	4		2	1	**23**
⊞ Night Shift	2	2	3	2	4	4	7	6	3	2	2	2	**39**
Total	**5**	**5**	**3**	**3**	**6**	**7**	**8**	**9**	**7**	**2**	**4**	**3**	**62**

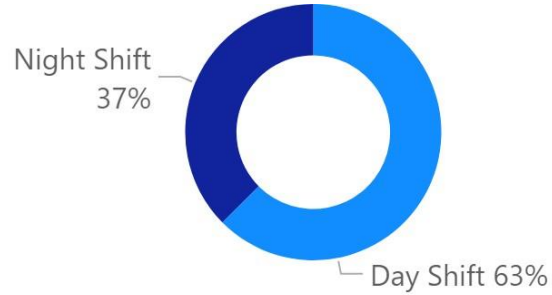
Missed Task Breakdown



204
Attended

South West

Current Demand

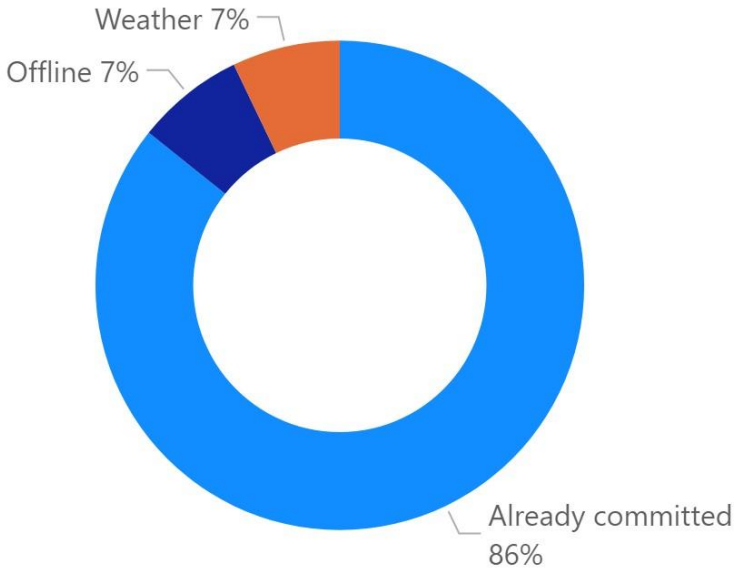


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1	1	1	3	1	5			5	2	1	**21**
1		4	3	1	3	1	2	3	4	2	1	1	**25**
2	2	1			1			3	2	2	2	2	**15**
3			2		3		1	1	1	2			**10**
4	1	1	3		1		2	1			1	5	**15**
5	2					3		1	3	1	1	1	**12**
6	1	1	2	1				2	2	1	1	2	**13**
7	2	2	1	1	3	2	1	3	3	2	2	1	**23**
8			2	1	4	6	3	1	2	3	3	3	**28**
9	4	3	2	3	2	1	4	3	4	4	2	2	**34**
10	3	2	5	2	1	6	6	3	6	2	7	5	**48**
11	8	5	7	6	7	4	7	4	3	3	4	3	**61**
12	4	2	6	7	7	5	5	1	8	2	7	6	**60**
13	5	5	7	5		2	3	9	2	9	6	10	**63**
14	4	2	6	4	1	6	6	5	4	6	2	6	**52**
15	4	7	2	8	5	2	1	4	3	5	7	6	**54**
16	5	1	6	5	5	7	6	4	2	2	5	6	**54**
17	4	5	4	10	2	3	4	5	6	2	3	5	**53**
18	7	5	2	6	3	5	3	3	5	2	3	1	**45**
19	4	6	2	3	5	5	4	7		3	3	3	**45**
20	6	1	2	2	4	4	6	5	3	1	4	4	**42**
21	2	1	2	2	3	6	7	2	3	7	6	1	**42**
22		1	5	4	5	4	3	4	4	1	3	2	**36**
23	3	1	6	1	4	5	2	2	5	5	1	5	**40**
Total	**72**	**57**	**78**	**73**	**72**	**78**	**81**	**76**	**75**	**72**	**76**	**81**	**891**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	50	39	50	58	40	49	49	45	48	42	51	54	**575**
⊞ Night Shift	22	18	28	15	32	29	32	31	27	30	25	27	**316**
Total	**72**	**57**	**78**	**73**	**72**	**78**	**81**	**76**	**75**	**72**	**76**	**81**	**891**

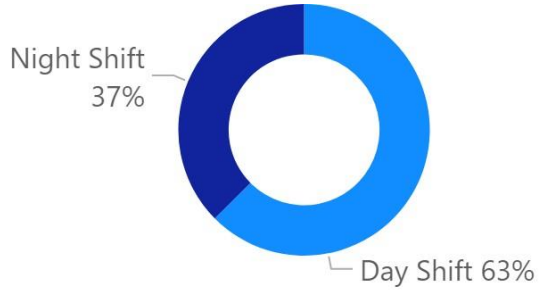
Missed Task Breakdown



650
Attended

South West

Umet need

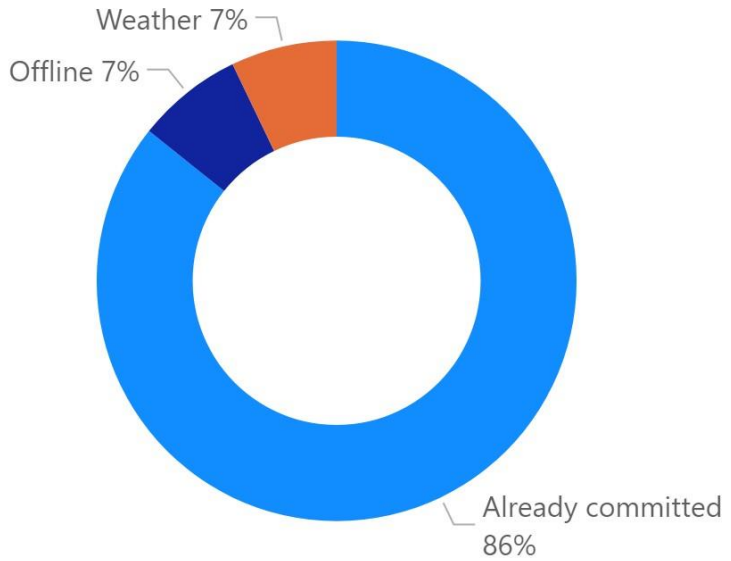


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1			2		3			5	1		13
1		3	1	1	2	1		1	3	1		1	14
2		1							1		1		3
3			2		1					2			5
4	1		1								1	2	5
5						1		1	2				4
6	1												1
7								1					1
8					1	1							2
9	1	2			1		2		2				8
10				2		2	2				1		7
11	1	1	2	2	1		1					1	9
12	1					2	1		1			1	6
13	1		2					3					6
14			2	1			2	1		2		2	10
15	2	1		1	1	1			1	2		1	10
16	2	1		1	1	1	1				1		8
17	3	2		3				2	1			2	13
18		3			2	2	2		2		1		12
19	2	3	1	2	3	1		3		1			16
20	3		2	2	2	2	2	3	2	1	2	2	23
21	1	1	1			5	6	1	2	2	4		23
22			4	2	3		2	3	1	1	3		19
23		1	3	1	2	5	2	1	3	2	1	2	23
Total	**20**	**20**	**21**	**18**	**22**	**24**	**26**	**20**	**21**	**19**	**16**	**14**	**241**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	11	10	6	10	7	9	11	7	7	4	3	7	**92**
⊞ Night Shift	9	10	15	8	15	15	15	13	14	15	13	7	**149**
Total	**20**	**20**	**21**	**18**	**22**	**24**	**26**	**20**	**21**	**19**	**16**	**14**	**241**

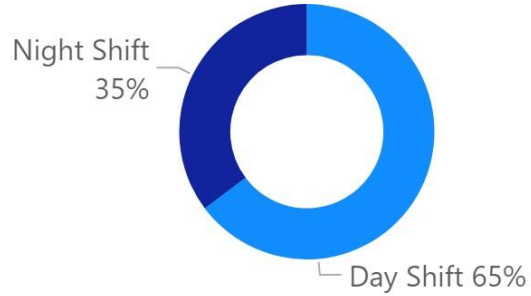
Missed Task Breakdown



650
Attended

Hywel Dda

Current Demand

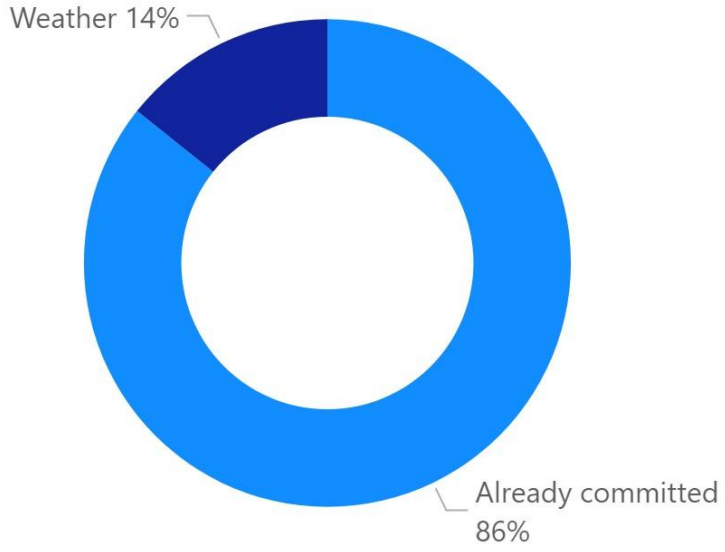


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0			1	2	2		3			5	1		**14**
1	1	2	1	1	2	1	2	2	4	1		1	**18**
2	1	1			1	1	1	1	2	1	1	2	**12**
3			2		3					2			**7**
4	1		1	1	2						1	6	**12**
5						1			2	1	1	1	**6**
6	1				1	1		1	2	1		1	**8**
7	2	1	1		4	1	1	1	1	1	2	1	**16**
8	1		1		5	3	3	1	1	3	1	2	**21**
9	3	1	3	4	2		3	4	4	2	1	3	**30**
10	2	1	5			6	6	3	2	1	3	3	**32**
11	5	3	2	4	4	3	7	5	2	3	2	3	**43**
12	4	1	5	3	8	4	7	2	6	1	4	5	**50**
13	4	2	7	3		3	4	6	2	6	4	4	**45**
14	2	1	3	2	2	6	3	3	4	3		4	**33**
15	3	4	2	4	4	3	3	4	3	3	5	3	**41**
16	6	1	4	3		4	4	3	2	1	5	5	**38**
17	5	2	3	5	2	3	2	6		2	2	2	**34**
18	4	3		3	1	5		3	3	1	2		**25**
19	2	5	1		2	4	2	5	1		4	1	**27**
20	2		1	2	3	4	6	3	3	1	4	1	**30**
21	2	1	2	2		2	8		1	3	5	1	**27**
22	1		3	1	4	4	2	2	2	1			**20**
23	1	1	4		5	4		2	3	4		3	**27**
Total	**53**	**30**	**52**	**40**	**57**	**63**	**67**	**57**	**50**	**47**	**48**	**52**	**616**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	41	20	36	31	32	41	43	41	30	27	31	35	**408**
⊞ Night Shift	12	10	16	9	25	22	24	16	20	20	17	17	**208**
Total	**53**	**30**	**52**	**40**	**57**	**63**	**67**	**57**	**50**	**47**	**48**	**52**	**616**

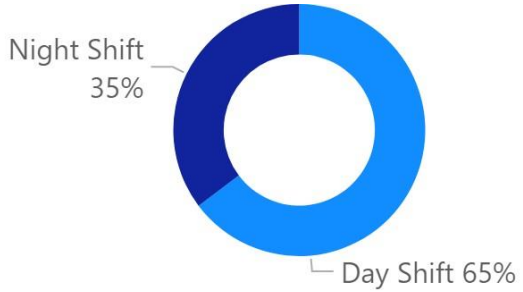
Missed Task Breakdown



469
Attended

Hywel Dda

Umet need

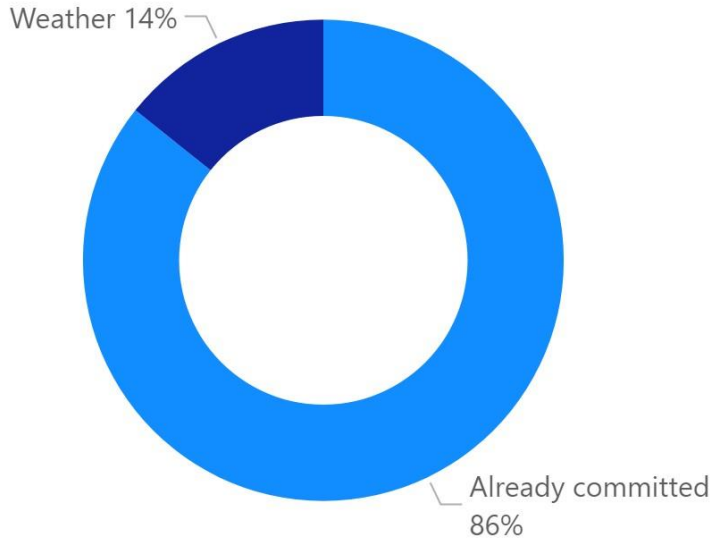


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0					1		1			4			6
1		2		1	1	1			3	1		1	10
2		1				1	1		1				4
3			2		1					2			5
4	1		1	1							1	3	7
5									2				2
6	1					1							2
7													
8	1				1								2
9	1				1		1		1				4
10						1	2						3
11				1	1		1					1	4
12						1	1						2
13			2					2					4
14			1					1					2
15	1	1			1	1						1	5
16	4			1		1					1		7
17	4							2					6
18		1			1	2			1		1		6
19		2			1	1		4					8
20	1		1	2	2	2	2	1	3		3	1	18
21	2	1	1			2	6		1		3		16
22			2		2		1	1		1			7
23		1	3		3	4		1	2	2		1	17
Total	**16**	**9**	**13**	**6**	**16**	**18**	**16**	**12**	**14**	**10**	**9**	**8**	**147**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	11	2	3	2	5	6	5	5	2		2	2	**45**
⊞ Night Shift	5	7	10	4	11	12	11	7	12	10	7	6	**102**
Total	**16**	**9**	**13**	**6**	**16**	**18**	**16**	**12**	**14**	**10**	**9**	**8**	**147**

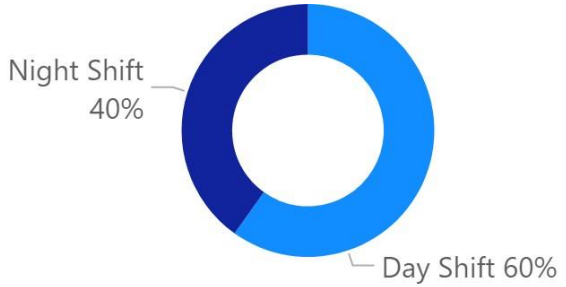
Missed Task Breakdown



469
Attended

Swansea Bay

Current Demand

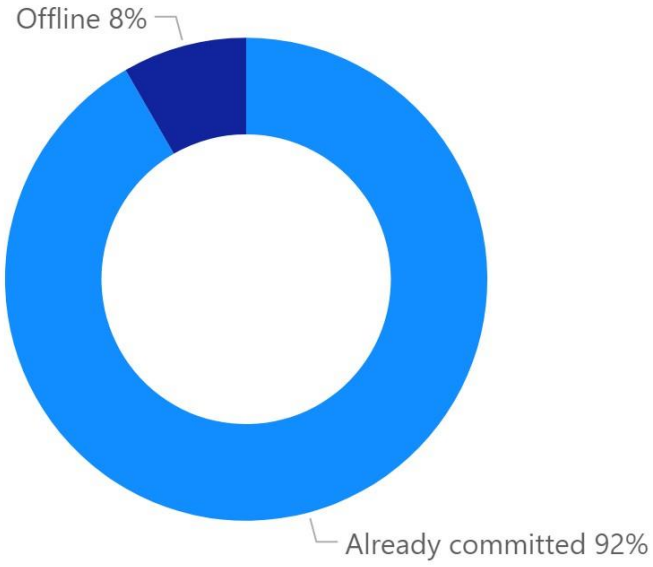


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1		2	4	3	5	1	1	1	2	2	**23**
1		3	3	1	1	2		1		2	1		**14**
2	2				1	1		4	3	1	2	1	**15**
3					1		2	2	1			1	**7**
4		1	2				2	3				1	**9**
5	2					2	1	2	2				**9**
6		1	2	1		1		1			1	1	**8**
7		1	1	2	1	2		3	3	1	2	1	**17**
8			1	1	1	3		1	3	2	3	2	**17**
9	1	2		1		1	2	2	1	2	2		**14**
10	2	3	1	3	2	4	3	3	4	2	5	2	**34**
11	4	5	6	7	5	1	3	1	2	2	2	1	**39**
12	1	1	3	5	6	4			3	6	4	1	**34**
13	2	3	2	2	2	1	3	5		4	4	7	**35**
14	3	2	4	4	2	2	3	5	2	5	3	2	**37**
15	2	5	4	6	2	1	1	1	2	3	2	4	**33**
16	1	1	5	4	5	5	4	5	2	3	1	3	**39**
17		5	4	6	2	3	4	2	10		1	5	**42**
18	3	2	2	4	2	2	5		2	1	3	3	**29**
19	3	4	1	5	4	4	2	3	1	4		2	**33**
20	7	1	2		2	3	2	5	3	2	1	5	**33**
21	2	2	2	1	3	5	2	2	3	6	3		**31**
22		2	5	5	2	2	1	2	3		4	2	**28**
23	3		2	3		2	2	1	4	2	1	2	**22**
Total	**39**	**45**	**52**	**63**	**48**	**54**	**47**	**55**	**55**	**49**	**47**	**48**	**602**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	19	30	33	45	30	29	28	28	34	31	32	31	**370**
⊞ Night Shift	20	15	19	18	18	25	19	27	21	18	15	17	**232**
Total	**39**	**45**	**52**	**63**	**48**	**54**	**47**	**55**	**55**	**49**	**47**	**48**	**602**

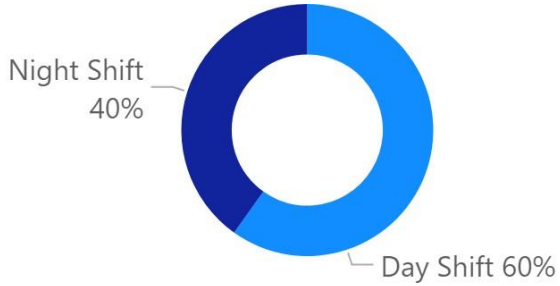
Missed Task Breakdown



418
Attended

Swansea Bay

Umet need

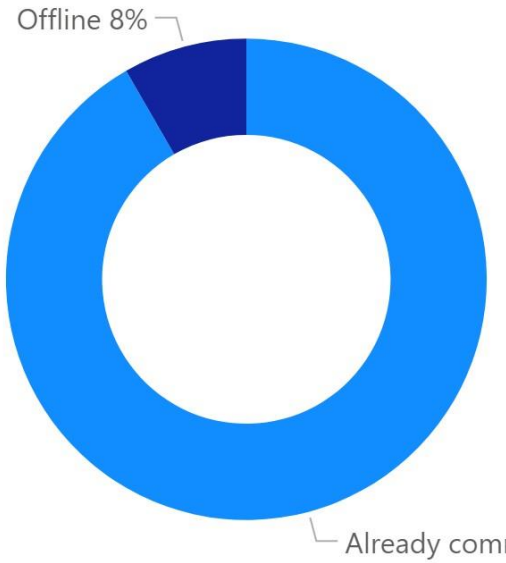


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	1			2	1	2		1	1	2	1	**12**
1		1	2	1	1	1		1					**7**
2						1		2			2		**5**
3					1			1					**2**
4												1	**1**
5						1		2	1				**4**
6													
7								1					**1**
8					1	1		1					**3**
9		2					1		1		1		**5**
10				2		1				1	1		**5**
11	1	3	2	3			1						**10**
12	1			1	1	1			1			1	**6**
13	1				1	1		1					**4**
14			1	1		1	2		1	2		2	**10**
15	1		1	1					1	2			**6**
16		1	2		1	2	2	1					**9**
17		2	1	3				1	2			2	**11**
18		2			1		2		1		1		**7**
19	2	3	1	3	3				1	1			**14**
20	3		2		1	3	1	3	2	1		2	**18**
21		2	1	1		4	2	1	1	4	2		**18**
22		1	3	4	1		1	2	1		3		**16**
23				1		2	2		3		1	1	**10**
Total	**10**	**18**	**16**	**21**	**14**	**20**	**16**	**17**	**17**	**12**	**13**	**10**	**184**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	4	10	7	11	5	7	8	5	7	5	3	5	**77**
⊞ Night Shift	6	8	9	10	9	13	8	12	10	7	10	5	**107**
Total	**10**	**18**	**16**	**21**	**14**	**20**	**16**	**17**	**17**	**12**	**13**	**10**	**184**

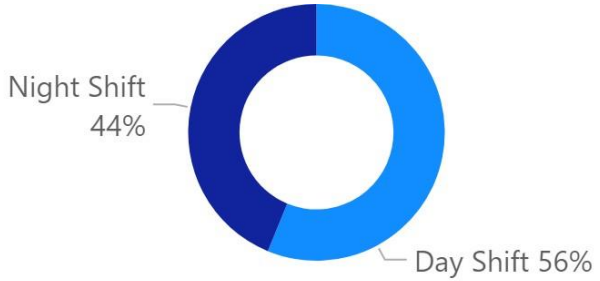
Missed Task Breakdown



418
Attended

South East

Current Demand

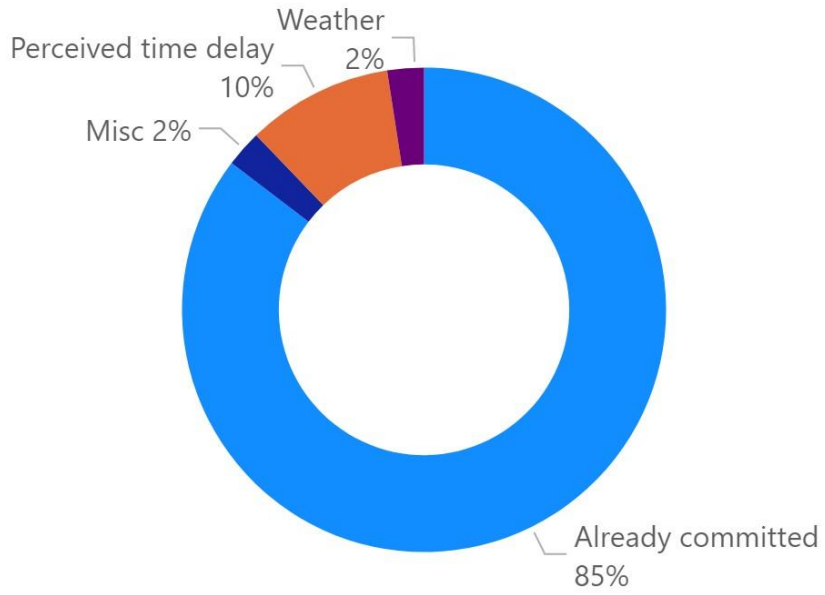


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	8	7	5	8	12	6	8	7	9	9	4	10	**93**
1	4	5	4	11	7	8	5	6	4	9	2	6	**71**
2	1	5	4	4	4	3	3	7	7	7	8	4	**57**
3	5	5	3	6	2	2	6	5		9	4	5	**52**
4	2	3	3	6	5	3	1	3	4	2	3	4	**39**
5	4	3	3	3	2	6	2	3	3		4	5	**38**
6	2	3	3	2	4	3	6	4	2		8	2	**39**
7	7	7	9	6	5	5	9	5	6	6	6	6	**77**
8	9	6	5	10	8	4	11	4	7	6	6	1	**77**
9	9	7	4	7	7	7	5	6	11	8	8	6	**85**
10	6	9	9	15	8	9	4	14	13	9	9	12	**117**
11	15	11	12	16	9	7	9	10	19	14	8	16	**146**
12	9	14	14	8	17	15	11	10	17	13	10	10	**148**
13	7	8	8	8	12	8	11	8	7	6	7	10	**100**
14	12	12	8	12	9	4	9	13	17	13	7	11	**127**
15	14	6	15	12	9	10	8	10	11	13	10	11	**129**
16	9	8	11	12	7	6	9	10	12	10	10	7	**111**
17	13	12	11	6	8	8	11	6	16	11	9	7	**118**
18	1	6	8	11	10	9	10	6	12	7	9	9	**98**
19	8	8	13	8	9	14	14	10	13	9	11	6	**123**
20	13	9	9	10	12	20	21	9	4	11	13	7	**138**
21	8	10	7	12	8	16	16	6	8	7	12	7	**117**
22	6	9	11	12	8	10	9	13	13	12	10	9	**122**
23	10	5	5	12	13	18	7	7	11	9	10	7	**114**
Total	**182**	**178**	**184**	**217**	**195**	**201**	**205**	**182**	**226**	**200**	**188**	**178**	**2336**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	111	106	114	123	109	92	107	102	148	116	99	106	**1333**
⊞ Night Shift	71	72	70	94	86	109	98	80	78	84	89	72	**1003**
Total	**182**	**178**	**184**	**217**	**195**	**201**	**205**	**182**	**226**	**200**	**188**	**178**	**2336**

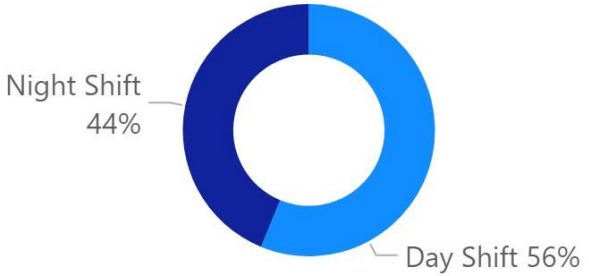
Missed Task Breakdown



1797
Attended

South East

Umet need

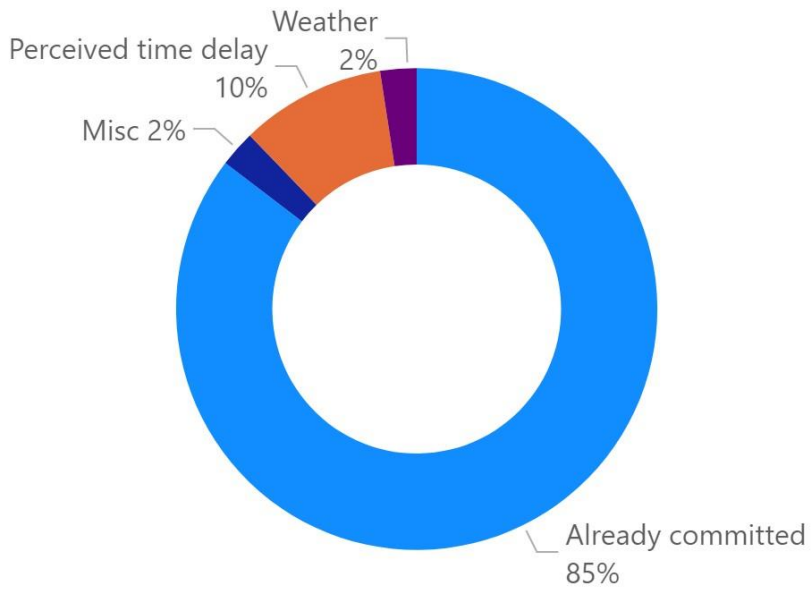


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	2	1	1	3	2	5	2	3	4	3	1	4	**31**
1	2		2	6	5	3		3	1	3	1	4	**30**
2		1	2	1	3	1	2	4		3	1		**18**
3	1	1	1	1		1	4	2		3		1	**15**
4		2		2			1	1	2	1	1	1	**11**
5	1		1					2	1		1	2	**8**
6	1					1	2	1			2	1	**8**
7	1						3			1		2	**7**
8		1		2	2	1	3	1					**10**
9			1	1	2	1	1	1	4		2	1	**14**
10		1						2	1	1	1	3	**9**
11	3	2	1	5		1	2	4	1			2	**21**
12	1		1	2	5		1		1			1	**12**
13	4	2	1	3	2	3	2		1			1	**19**
14	2	2		2		1	2	4	2	2		3	**20**
15	3	2	2	1		2		2			2	1	**15**
16	4	2	3	3		1	3	2	2	2	1	1	**24**
17	6	2	1	2	1		3	1	3	1	1	1	**22**
18		2	1	3	2		4	1	1	1	2	2	**19**
19	1	4	4	2	4	3	4	3	5	3	2		**35**
20	4	2	5	4	7	12	10	4	2	4	4	2	**60**
21	4	4	3	5	2	9	8	4	2	5	6	1	**53**
22		1	4	7	3	7	3	3	3	1	3	3	**38**
23	2	3	2	4	6	7	1	4	5	1	4	1	**40**
Total	**42**	**35**	**36**	**59**	**46**	**59**	**61**	**52**	**41**	**35**	**35**	**38**	**539**

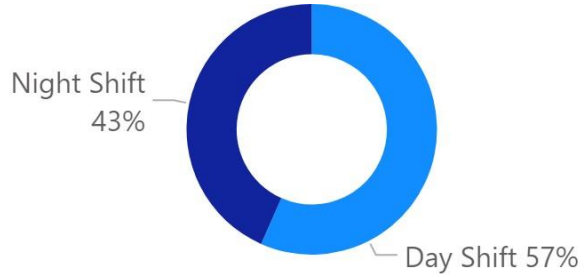
Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	24	16	11	24	14	10	24	18	16	8	9	18	**192**
⊞ Night Shift	18	19	25	35	32	49	37	34	25	27	26	20	**347**
Total	**42**	**35**	**36**	**59**	**46**	**59**	**61**	**52**	**41**	**35**	**35**	**38**	**539**

Missed Task Breakdown



1797
Attended

Cwm Taf ... Current Demand

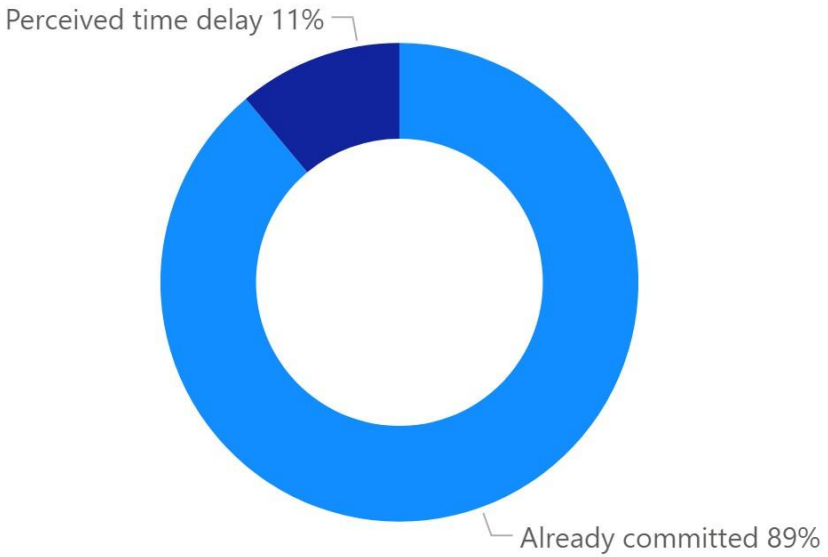


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	2	1	2	3	4	1			2	3		5	**23**
1		1	1	1	1			2	1	2	1	2	**12**
2		2	1	1					1	3	6	2	**16**
3	3	1		3		1		2		2		3	**15**
4				1	2	1			1	1		1	**7**
5	1	1			1				1		2	4	**10**
6		2	1		3	1	1	2			3		**13**
7	4	2		3	1	1		3	2	1		1	**18**
8	4	2	4	5	1	2	3			2	1	1	**25**
9	4	2	1	1	1	1	3		2	2	1	1	**19**
10	1	2	1	6	2	2		2	7	3	1	2	**29**
11	5	1	1	4	4	1	1	4	1	3	2	1	**28**
12	2	5	2	2	4	3	3	2	4	4	3	3	**37**
13	1		1	2	4	2	3	1		2	3	2	**21**
14		2	1	4	3	1	1	4	2	5	3	3	**29**
15	3		4	2	5	3	4	5	3	6	4	6	**45**
16	4	3			3	1	2	3	5	2	2	1	**26**
17	4	2	2	1	2	3	2	2	5	3	1	2	**29**
18		2		3	2	2	1	1	6	4	5	2	**28**
19	3	1	5	2	2	5	1	2	4	3	3	2	**33**
20	4	2		3	1	5	6	2	1	2			**26**
21	5	5	2	1	4	1	4	1	2	4	2	3	**34**
22	1	3	1		1	1	2	3	2	2	1	3	**20**
23	6	2		3	1	7	3	1	1	2	2	3	**31**
Total	**57**	**44**	**30**	**51**	**52**	**45**	**40**	**42**	**53**	**61**	**46**	**53**	**574**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	32	23	17	33	32	22	23	27	37	37	26	25	**334**
⊞ Night Shift	25	21	13	18	20	23	17	15	16	24	20	28	**240**
Total	**57**	**44**	**30**	**51**	**52**	**45**	**40**	**42**	**53**	**61**	**46**	**53**	**574**

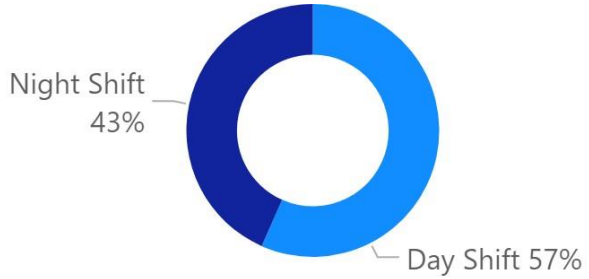
Missed Task Breakdown



495
Attended

Cwm Taf Morga...

Umet need

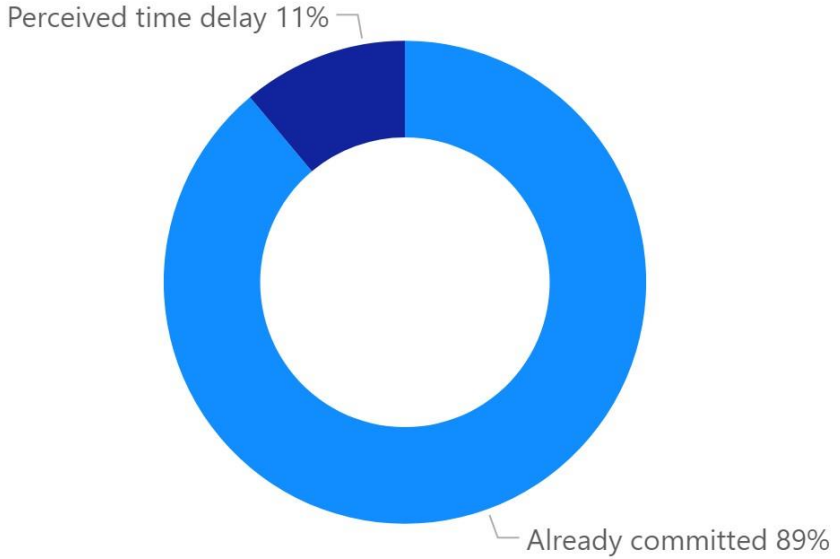


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1					1				1		2	5
1				1	1					1			3
2		1											1
3				1		1				1			3
4										1			1
5												1	1
6													
7	1												1
8				2		1							3
9					1				2		1		4
10									1			1	2
11	1		1					1					3
12					1								1
13				1									1
14		1								2		2	5
15								1					1
16	2	1					1		1				5
17	1	1											2
18		1		1			1	1			1	1	6
19	1		1					1	2				5
20	2				1	2		1					6
21	3	1		1			1	1	1	2		1	11
22					1	1	1					1	4
23	1	1				1	1			1			5
Total	**13**	**7**	**2**	**7**	**5**	**7**	**5**	**6**	**7**	**9**	**2**	**9**	**79**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	5	4	1	4	2	1	2	3	4	2	2	4	**34**
⊞ Night Shift	8	3	1	3	3	6	3	3	3	7		5	**45**
Total	**13**	**7**	**2**	**7**	**5**	**7**	**5**	**6**	**7**	**9**	**2**	**9**	**79**

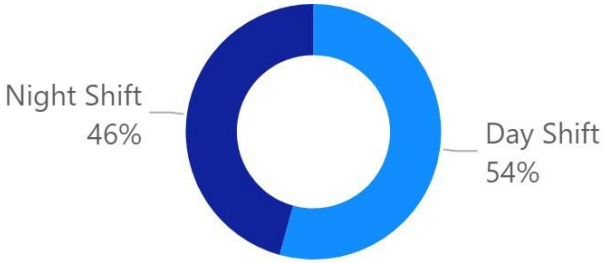
Missed Task Breakdown



495
Attended

Aneurin Bevan

Current Demand

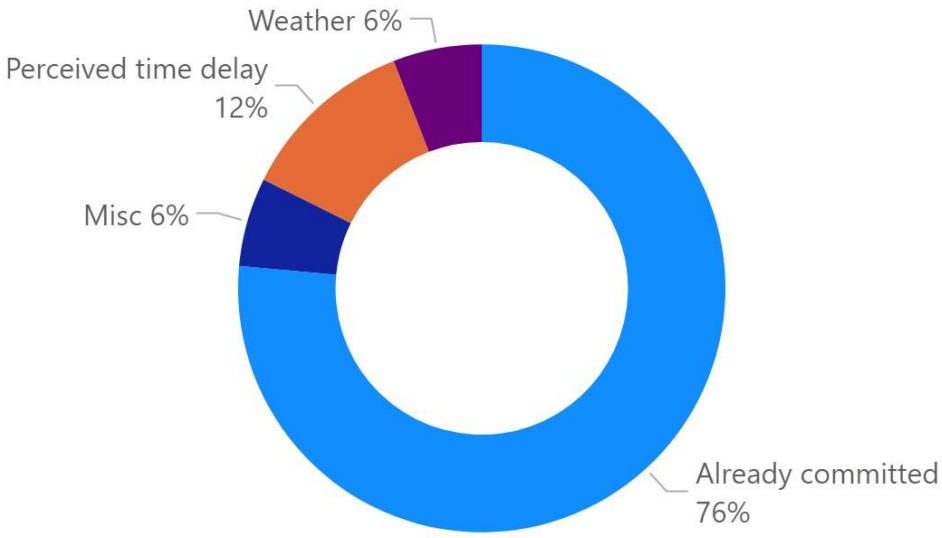


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	5	4	1	3	3	3	4	5	3	4	2	3	**40**
1	2	1	2	5	2	2	3		2	2	1		**22**
2		1	3	2	2	2	2	2	2	3	1	1	**21**
3		1	2	1	1	1	3			4	3	1	**17**
4	2		1	2	1	1	1	1		1	1	3	**14**
5	1	2	1	3	1	4	1	1	1		1	1	**17**
6	1			1	1	1	3	1			4	1	**13**
7	2	2	6		2	1	5	1	2	1	2	1	**25**
8	4	3	1	3	3	1	4	2	3	1			**25**
9	2	1	2	4	3	4	2	2	5	2	3	2	**32**
10	2	5	4	4	4	3	2	10	3	2	4	5	**48**
11	8	8	7	4	2	2	1	2	6	3	3	6	**52**
12	4	4	5	1	6	6	5	3	8	4	2	4	**52**
13	3	2	3	3	2	3	4	1	5	1		2	**29**
14	7	4	2	3	1	2	3	3	8	4	1	2	**40**
15	6	3	3	5	3	2	3	2	3	1	5	3	**39**
16	5	1	4	8	3	2	3	1	3	2	2	3	**37**
17	5	6	4	3		2	6	2	5	4	4	2	**43**
18	1	3	8	5	5	3	2	1	4		1	3	**36**
19	1	1	2	2	2	3	8	5	6	2	5	3	**40**
20	2	3	6	2	7	8	9	2	2	7	13	3	**64**
21	1	3	1	6	3	8	8	3	5	1	6	3	**48**
22	3	3	5	8	3	6	5	5	5	6	5	2	**56**
23	2	1	1	4	8	8	2	4	5	2	6	2	**45**
Total	**69**	**62**	**74**	**82**	**68**	**78**	**89**	**59**	**86**	**57**	**75**	**56**	**855**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	49	42	49	43	34	31	40	30	55	25	27	33	**458**
⊞ Night Shift	20	20	25	39	34	47	49	29	31	32	48	23	**397**
Total	**69**	**62**	**74**	**82**	**68**	**78**	**89**	**59**	**86**	**57**	**75**	**56**	**855**

Missed Task Breakdown



643
Attended

Aneurin Bevan

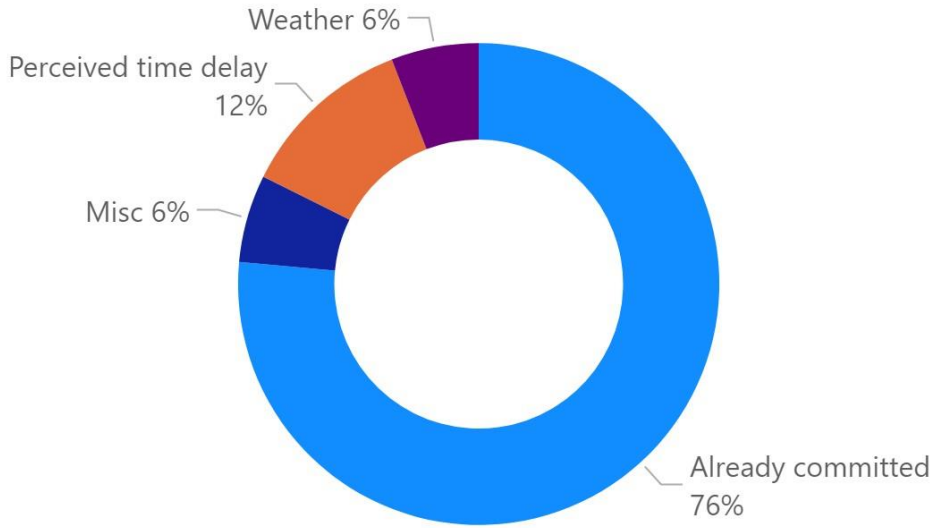
Umet need

Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1			2	1	3		2	2	2		1	14
1	2		1	2	2				1		1		9
2			2		1		1			2			6
3			1				2			1		1	5
4							1	1				1	3
5	1		1					1				1	4
6						1	1	1			2	1	6
7							2						2
8		1					1						2
9			1			1	1		2				5
10		1						2			1	2	6
11	2			2		1						1	6
12	1		1		1		1		1			1	6
13	3			2		1	2						8
14	2			1				2	1			1	7
15	2							1			2	1	6
16	2			2					1		1	1	7
17	4	1		1			2		1		1		10
18		1	1	2	1		1					1	7
19					1	1	1	1	2	2	1		9
20		1	3	1	3	4	5	1	1	3	4		26
21		1	1	1	2	5	5	1	1	1	4		22
22			2	4		3	1		1	1	1		13
23		1		2	6	4		4	2		4		23
Total	**20**	**7**	**14**	**22**	**18**	**24**	**27**	**17**	**16**	**12**	**22**	**13**	**212**
Total	**20**	**7**	**14**	**22**	**18**	**24**	**27**	**17**	**16**	**12**	**22**	**13**	**212**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	16	4	3	10	2	3	10	5	6		5	8	**72**
⊞ Night Shift	4	3	11	12	16	21	17	12	10	12	17	5	**140**
Total	**20**	**7**	**14**	**22**	**18**	**24**	**27**	**17**	**16**	**12**	**22**	**13**	**212**

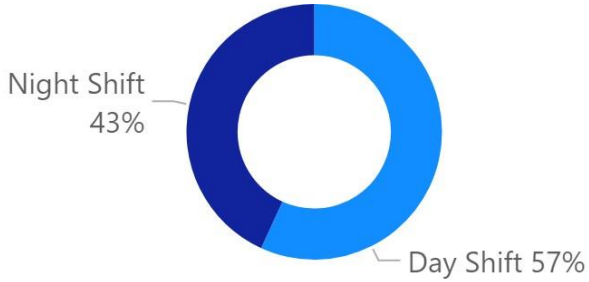
Missed Task Breakdown



643
Attended

Cardiff and Vale

Current Demand

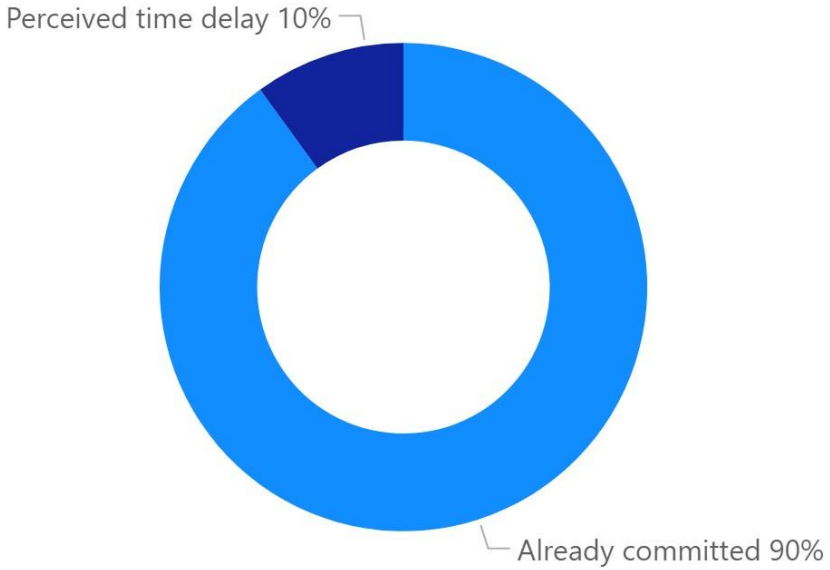


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0	1	2	2	1	3		2	1	3	2	1	1	**19**
1	2	2		4	4	4	2	4	1	4		4	**31**
2		2		1	2		1	3	1	1		1	**12**
3	2	3	1	2	1		2	2		3	1		**17**
4		3	2	3	2	1			3		2		**16**
5	2		2			2		1	1		1		**9**
6	1	1	2	1			2	1	2		1	1	**12**
7	1	3	2	2	1	2	4		1	4	3	3	**26**
8	1	1		2	3	1	4	1	2	1	4		**20**
9	3	4	1	1	3	2		3	4	4	3	3	**31**
10	2	1	4	4	1	2	1	1	3	3	4	5	**31**
11	1		3	3	1	4	6	4	11	7	3	8	**51**
12	3	5	6	4	4	5	3	5	4	1	5	3	**48**
13	3	6	2	3	4	2	2	4	2	3	2	6	**39**
14	4	5	4	3	3		5	3	6	2	2	6	**43**
15	4	2	5	3	1	5		2	5	6	1	1	**35**
16		4	4	3	1	2	3	3	2	4	5	2	**33**
17	4	3	2	2	5		1	1	2	4	4	1	**29**
18		1		2	3	3	5	4	2	3	1	2	**26**
19	4	5	6	2	4	3	5	3	2	3	3	1	**41**
20	4	4	2	5	4	4	5	3		1		3	**35**
21	1	1	2	4	1	6	3	2			3	1	**24**
22	2	2	2	2	4	3	2	5	5	4	3	4	**38**
23	1	2	4	3	4	3	2	1	3	4	2	2	**31**
Total	**46**	**62**	**58**	**60**	**59**	**54**	**60**	**57**	**65**	**64**	**54**	**58**	**697**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	26	35	33	32	30	28	34	31	44	42	37	40	**412**
⊞ Night Shift	20	27	25	28	29	26	26	26	21	22	17	18	**285**
Total	**46**	**62**	**58**	**60**	**59**	**54**	**60**	**57**	**65**	**64**	**54**	**58**	**697**

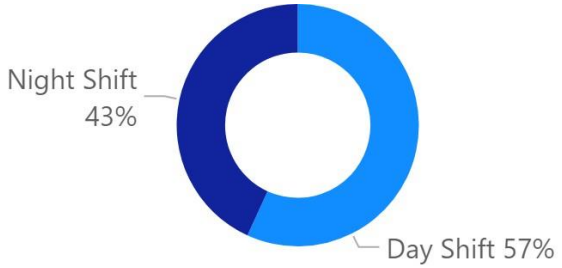
Missed Task Breakdown



512
Attended

Cardiff and Vale

Umet need

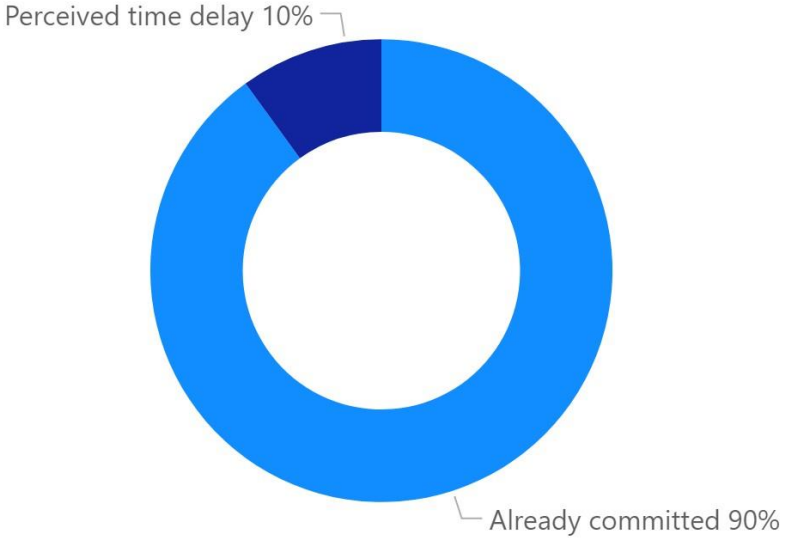


Month

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
0		1	1	1			2	1	1				7
1				2	2	2		3		2		4	15
2				1	2		1	2		1			7
3	1	1					2	1		1			6
4		2		2					2		1		7
5									1		1		2
6	1						1						2
7							1			1		2	4
8					1		2						3
9				1	1			1				1	4
10													
11				1			1	3	1			1	7
12				1	2								3
13	1	2	1		1	1			1			1	8
14		1		1			2	2					6
15	1	2	1	1		2							7
16		1	1	1			1	1		2			7
17	1			1	1		1		1	1		1	7
18					1		2		1	1			5
19		3	3	1	2	2	3	1		1	1		17
20	1	1	1	3	3	3	5	1		1		2	21
21	1	1	1	2		3	1	2			2		13
22			1	1	2	3	1	3	2		2	2	17
23	1	1	2	2		2			1			1	10
Total	**8**	**16**	**12**	**22**	**18**	**18**	**26**	**21**	**11**	**11**	**7**	**15**	**185**

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	Total
⊞ Day Shift	3	6	3	7	7	3	10	7	4	5		6	**61**
⊞ Night Shift	5	10	9	15	11	15	16	14	7	6	7	9	**124**
Total	**8**	**16**	**12**	**22**	**18**	**18**	**26**	**21**	**11**	**11**	**7**	**15**	**185**

Missed Task Breakdown



512
Attended

9 Appendix H Optima EMRTS Unmet Need Scenarios 01 – 04 (V2)

www.csamhealth.com/solutions/public-safety

UNMET NEED SCENARIOS:

SCENARIOS 01 - 04

EMERGENCY MEDICAL RETRIEVAL AND TRANSFER SERVICE

Version 2.0
28 May 2022

Created by: Tef Jansma Optima Predict version: 22.4.0.54394

To protect the environment, please do not print this document unless necessary.

9.1.1 EXECUTIVE SUMMARY

CSAM Optima has developed a model of the Emergency Medical Retrieval and Transfer Service (EMRTS) operations in CSAM Optima Predict, an advanced discrete event simulation solution. As baseline model tuning requires all workload and resources to be included, this also included the 'uncommissioned' H67 daytime incidents and shifts. The following adjustments have been made to the initial baseline to create the "Adjusted Baseline":

- Exclude H67 daytime incidents from the historical incidents & responses data and remove the H67 daytime shift from the model.
- Add the Unmet Need data to the incidents & responses data. The resulting dataset contains 2,902 + 1,865 = 4,767 incidents. Most of the unmet need occurs in the evenings and nights.
- Add 45 minutes of post-transport unavailability. This is to allow for refuelling and restocking.
- Implement "incident abandonment logic". If no resource is available, incidents are queued until a resource becomes available. If no suitable resource has been found within 60 minutes, there is a 1% probability per minute that the incident becomes 'abandoned'. Once an incident is abandoned, the incident is removed from the queue and the model no longer attempts to respond to it.

EMRTS has asked CSAM Optima to model the impact of four scenarios in CSAM Optima Predict. These four scenarios 'stack' on top of each other:

Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport.

Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at Caernarfon, Welshpool, Conwy or Denbighshire.

Scenario 3:

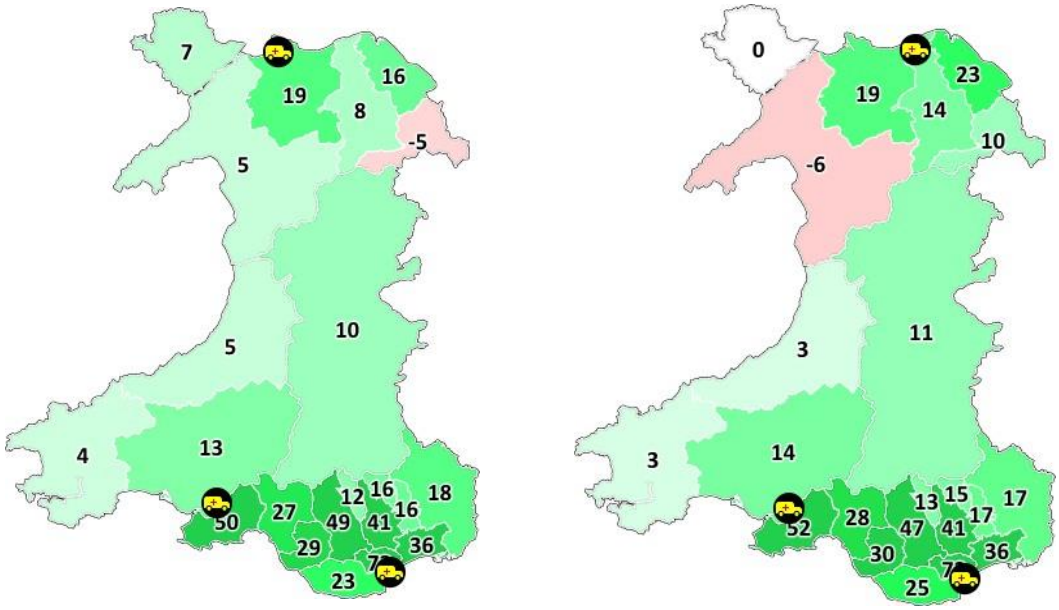
- Option 1, "Scenario 3 (car)": add a second crew shift (car-only) to the merged base of Scenario 2.
- Option 2, "Scenario 3 (air)": or allow the second crew to also respond with a second helicopter.

Scenario 4:

- Option 1, "Scenario 4 (change)": based on scenario 3 (car), change start time of the Cardiff day crew.
- Option 2, "Scenario 4 (car): based on scenario 3 (car), add a second Cardiff day crew (car-only).

In a nutshell, the results in the report show consistent increases in the number of scene arrivals, and decreases in the average response duration, as the report progresses through scenarios 1 up to 4. It is up to the service what the balance is between maximising the number of scene arrivals, (cost-) effectiveness, and efficiency. Below are a few highlights of the results:

- Merging Caernarfon and Welshpool is best done into Conwy or Denbighshire. Both options lead to a very similar number of scene arrivals and (geographical distribution of) response durations.
- As a rule of thumb, the strongest increases in the number of scene arrivals are seen when moving/adding shifts so that they start at 14:00 hours. However, they don't always lead to the fastest average response durations.
- The best performing scenarios in this report are those where Caernarfon and Welshpool are merged into either Conwy or Denbighshire; then adding a second car-only crew to the merged base at 14:00 hours; then adding a car-only crew to Cardiff at 14:00 hours. This increases the number of simulated scene arrivals from 2,743 to 3,217 - 3,229. It decreases the simulated average response duration from 1:05:35 minutes to 54:13 - 54:35 minutes. The images below show how the number of scene arrivals has changed compared to the Adjusted Baseline. **Left** shows this for scenario "4A Conwy car + Cardiff car". **Right** shows this for "4B Denbighshire car + Cardiff car":



- The combination of adding a second helicopter for the extra crew at Conwy/Denbighshire + adding a car-only crew to Cardiff has not yet been explored. This can be done in follow-up modelling. This will very likely be an even better performing scenario, as it provides an additional helicopter to the merged base in north Wales.

CSAM Optima welcomes any follow-up questions, requests to model any unexplored options, or to re- run existing scenarios based on new insights or new assumptions.

CONTENTS

1 GLOSSARY

The following abbreviations and terms are used in this report:

Abbreviation	Description
EMRTS	Emergency Medical Retrieval and Transfer Service
CSAM Optima Predict	Advanced simulation modelling software from CSAM Optima
H57, H59, H61, H67	Callsigns (car/helicopter names)
WAST	Welsh Ambulance Service Trust

2 INTRODUCTION

The Emergency Medical Retrieval and Transfer Service (**EMRTS**) has asked CSAM Optima to model the impact of four scenarios in CSAM Optima Predict. These four scenarios 'stack' on top of each other:

Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport.

Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at Caernarfon, Welshpool, Conwy or Denbighshire.

Scenario 3:

- Option 1, "Scenario 3 (car)": add a second crew shift (car-only) to the merged base of Scenario 2.
- Option 2, "Scenario 3 (air)": or allow the second crew to also respond with a second helicopter.

Scenario 4:

- Option 1, "Scenario 4 (change)": based on scenario 3 (car), change start time of the Cardiff day crew.
- Option 2, "Scenario 4 (car): based on scenario 3 (car), add a second Cardiff day crew (car-only).

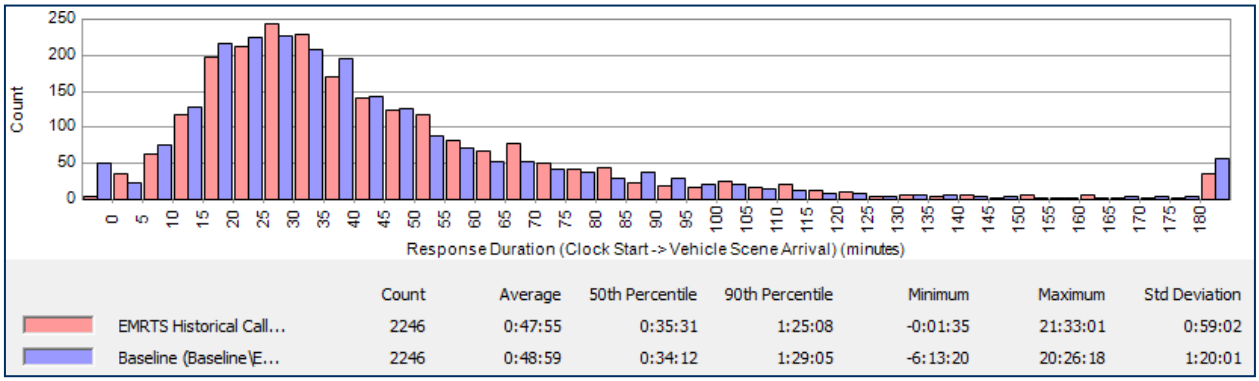
Scenario 4 builds on scenario 3, which builds on scenario 2, which builds on scenario 1. Hence, it is highly recommended to read the report in full from start to end to understand the 'journey' as certain decisions are taken throughout the report to limit the number of scenarios. Alternatively, there is a Summary of Results section near the end of the report or an Executive Summary.

3 METHODOLOGY

3.1 Baseline

CSAM Optima has developed a model of the EMRTS operations in CSAM Optima Predict, an advanced discrete event simulation solution. On the 22nd of March 2022, CSAM Optima delivered the Tuning Report to EMRTS. The Tuning Report describes how the outputs of the EMRTS model compare to historical data. Below is a selection of baseline characteristics that are most relevant for this modelling.

The EMRTS baseline model was tuned on 3,105 historical incidents from 1 January 2021 - 31 December 2021. As baseline model tuning requires all workload and resources to be included, this also included the 'uncommissioned' H67 daytime incidents and shifts. As shown in the distribution of the Response Duration **below**, there are 2,246 incidents with a scene arrival. The pink bars are the historical data, the blue bars are simulated data by the baseline model. It can be seen that, as intended, the baseline model produces a similar response duration distribution as historical data:



	Count	Average	50th Percentile	90th Percentile	Minimum	Maximum	Std Deviation
EMRTS Historical Call...	2246	0:47:55	0:35:31	1:25:08	-0:01:35	21:33:01	0:59:02
Baseline (Baseline\E...	2246	0:48:59	0:34:12	1:29:05	-6:13:20	20:26:18	1:20:01

3.2 Adjusted Baseline

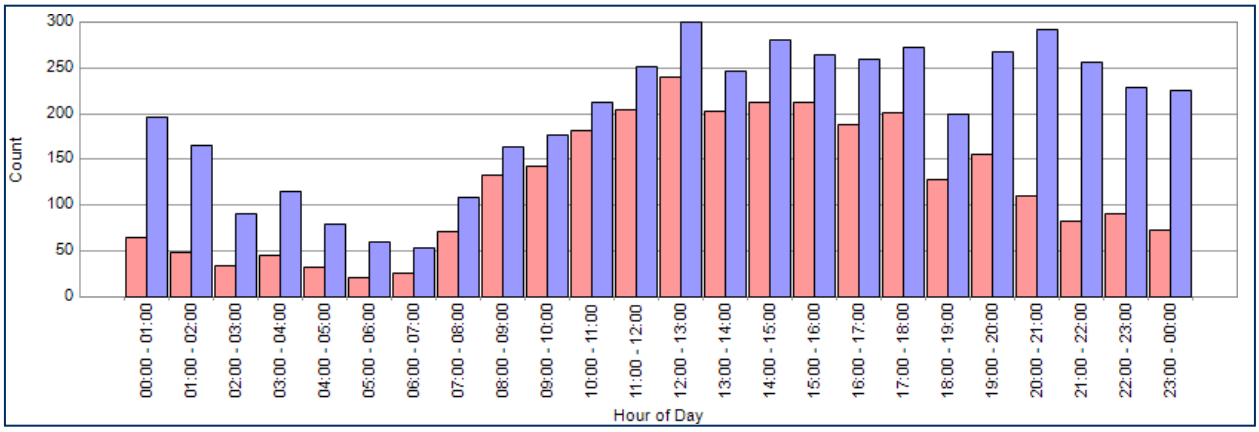
Following discussions with EMRTS, the following five adjustments have been made to the initial baseline to create the "Adjusted Baseline". This scenario serves as the reference starting point for all scenarios:

1) Exclude H67 daytime incidents from the historical incidents & responses data. As understood by CSAM Optima, the H67 daytime incidents should be excluded as they represent excess work that has not been commissioned. This reduces the number of incidents from 3,105 (with 2,246 arrivals) to 2,902 (with 2,075 arrivals).

2) Remove the H67 daytime shift from the model. Similar to the H67 daytime incidents, the H67 daytime shift has been removed from the model.

3) Add the Unmet Need data to the incidents & responses data. EMRTS has provided a list of incident numbers they would have ideally responded to, but haven't done so historically. Using this list, CSAM Optima has identified 1,865 additional incidents between 1 January 2021 - 31 December 2021 from the dataset of the Welsh Ambulance Service Trust (WAST). Hence, the resulting dataset contains 2,902 +

1,865 = 4,767 incidents. The count of incidents by hour of day is shown in the chart **below**. Pink is the historical data without H67 daytime incidents (2,902 incidents), blue is the historical data with the unmet need data added on top (4,767 incidents in total). This is the dataset that is used for all simulations. It can be seen that most of the unmet need occurs in the evenings and nights:



4) Add 45 minutes of post-transport unavailability. EMRTS has expressed that some extra resource unavailability should be present in the model. This is to allow for refuelling and restocking, and to prevent unrealistically high resource utilisation in the simulation model under certain possible scenarios. After discussions between CSAM Optima and EMRTS it was agreed to model this by delaying the vehicle clear time at hospital by 45 minutes. This prevents the simulation from re-assigning such vehicles to a new incident during those 45 minutes. The delayed vehicle clear time only applies to vehicles clearing after a transport. There is no delayed vehicle clear time for vehicles that do not transport or for vehicles that are stood down before they arrive at scene.

5) Implement "incident abandonment logic". By default, CSAM Optima Predict takes in all responded incidents and tunes simulation models based on that data. This is because, for traditional ambulance services, the demand is an input, not an output. However, EMRTS responds to selected incidents only out of a larger queue of incidents from WAST. This means that the responded demand for EMRTS is at least partially an output.

EMRTS was not able to provide a clear 'business rule' that describes which incidents they (want to) respond to and which not. EMRTS has agreed to model a queuing-time-dependent rule, as follows:

- The model attempts to respond to incoming incidents as normally. If no resource is available, incidents are queued until a resource becomes available (this is the default baseline behaviour).
- If no suitable resource has been found within 60 minutes, after that point there is a 1% probability per minute that the incident becomes 'abandoned'. Once an incident is abandoned, the incident is removed from the queue and the model no longer attempts to respond to it.

Most of the unmet need incidents are RED call priority. In real life, it may not be feasible to wait for 60+ minutes until an EMRTS resource arrives. However, the EMRTS model has no clinical information or interactions with WAST vehicles. Hence, any incident that has not been abandoned yet will remain queued in the EMRTS model, regardless of its clinical nature or possible interactions with WAST.

This incident abandonment logic also affects baseline outputs when the model cannot find a suitable resource within 60 minutes. Hence, this logic should *only* be used in datasets where the unmet need data is added on top of the historical data. For example, when run on 2021 historical data (with H67 daytime incidents excluded, H67 daytime shift excluded, and unmet need excluded), the incident abandonment logic causes the number of scene arrivals to reduce from 2,075 historically to 1,998 simulated (= -4% mismatch in how many incidents are responded to).

3.3 Assumptions and model limitations

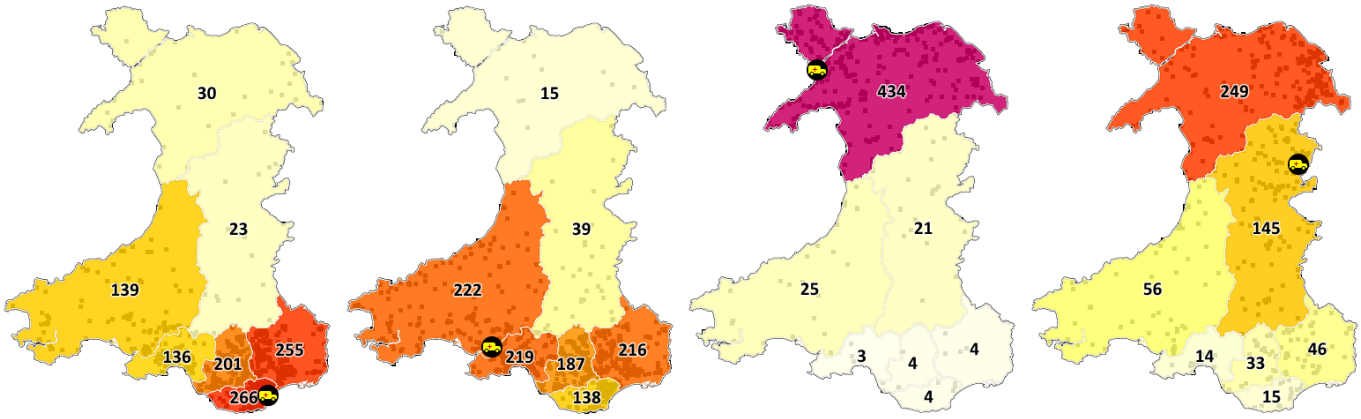
Below is a non-exhaustive list of assumptions and model limitations:

- All scenarios in the next chapters below are 'inherited' from the Adjusted Baseline that was described in the previous section. This means that any simplifications, bad data or wrong assumptions in the Adjusted Baseline are therefore also present in all scenarios. CSAM Optima is currently not aware of any bad data or too rigorous simplifications.
- CSAM Optima Predict can currently only model crews that are linked to a solo vehicle (car) or vehicle-pair (car + helicopter). However, in scenario 3 and scenario 4 there are bases where *two* crews can choose between *three* vehicles: two cars and one helicopter. This 'shared vehicle pool' is not modelled as such. Instead, one crew can choose between a car and a helicopter; the second crew can only respond by car.
- All simulated Crew Utilisations in this report have been calculated as [Vehicle Busy Unit Hours / Vehicle Shift Hours] * [number of vehicle shifts / number of crew shifts]. For a crew that can choose between a car or helicopter, this means that the crew utilisation is double the vehicle utilisation.
- All reported simulated response durations exclude negatives and durations above 600 minutes. This is to prevent the impact of bad data or extremely slow response durations that can skew averages.
- The size of the dataset (4,767 incidents) is smaller than what CSAM Optima believes to be robust from a statistical perspective. Hence, the Adjusted Baseline as well as all the scenarios have been run ten times using different random seeds. This reduces unwanted variation in simulation outputs, thereby increasing the accuracy of outputs even further.

4 HISTORICAL INCIDENTS, CREW HOURS & WORKLOAD

This section shows **historical data** only (1 Jan 2021 - 31 Dec 2021) and aims to give a high-level overview of the data as understood by CSAM Optima. This can be used to verify if the model contains the correct number of dispatches, scene arrivals, crew hours and utilisation. Note that the daytime Cardiff responses (H67) and associated shift hours have been filtered out of the data for the analysis in this section.

The images below show, for one base at a time, how often the crew from that base was dispatched to a health board region. From **left** to **right**: Cardiff, Dafen, Caernarfon, Welshpool. For example, the Cardiff crew (left) was dispatched 23 times to Powys (the region in the middle-right of Wales):



The table **below** shows information about dispatches, arrivals, crew hours and workload. CSAM Optima recommends checking this data to verify that the correct data and workload are in the model:

Item	Cardiff	Dafen	Caernarfon	Welshpool	All
Dispatches	1,050	1,036	495	558	2,902
Scene Arrivals	751	741	372	416	2,075
Hospital Arrivals*	401	498	186	193	1,278
Daytime crews (car + helicopter)	-	1	1	1	3
Nighttime crews (car + helicopter)	1	-	-	-	1
Crew Busy Unit Hours **	1,420	1,513	726	826	4,485
Post-Transport Unavailable Hours ***	85	89	85	73	384
Crew Shift Hours ****	4,380	4,380	4,380	4,380	17,520
Crew Utilisation (Estimated) *****	34%	36%	18%	20%	27%
* These figures include transports where EMRTS was assisting a vehicle from WAST.					
** Crew Busy Unit Hours is the Sum of [Vehicle Allocated Time ➔ Vehicle Clear Time].					
*** Currently not contained in historical data. Calculated as 45 minutes per transported incident.					
**** Assumes every crew works a daily 12-hour shift. Hence 365 x 12 = 4,380 hours per base.					
***** Utilisation here is defined as [Busy Unit Hours + Post-Transport Unavailable Hours] / Shift Hours.					

5 SIMULATION RESULTS

5.1 Scenario 1: add a daytime crew shift to Cardiff (air / car)

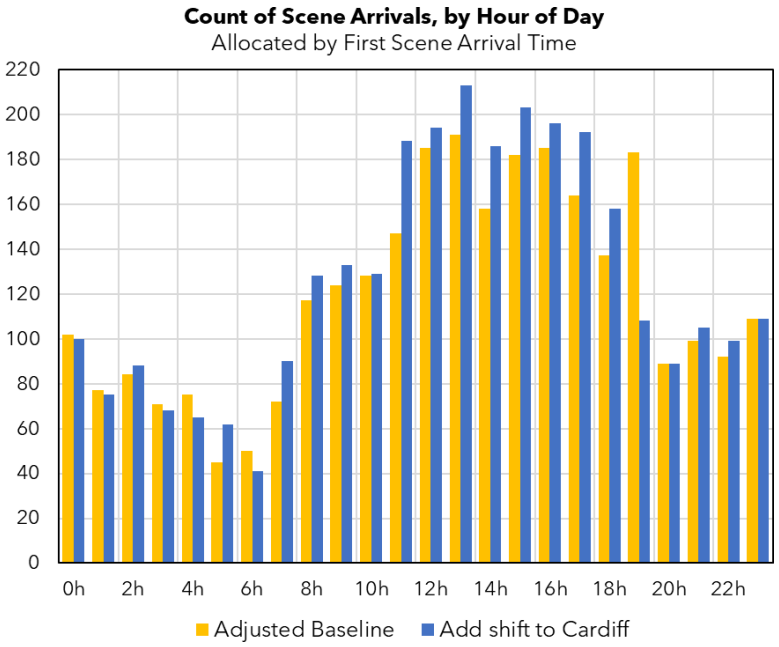
The table **below** shows the results of the Adjusted Baseline and Scenario 1 (Add shift to Cardiff):

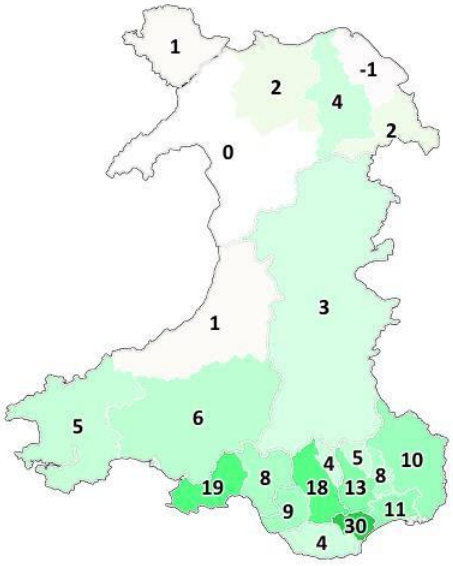
- The Adjusted Baseline excludes historical daytime Cardiff (H67) incidents and daytime Cardiff shift, but it has all unmet need added to it. The Adjusted Baseline is the reference point for all scenarios.
- Scenario 1 has an extra daily 07:00 - 19:00 crew shift in Cardiff. This crew shift can choose between a car or a helicopter for responses. Other than that, it is identical to the Adjusted Baseline.

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44

The results show that adding a daytime crew shift to Cardiff leads to more incidents being responded to (3,019 instead of 2,866). It also causes the overall utilisation and response duration to decrease.

- The chart **left below** shows *when* these scene arrivals are occurring. It shows that the largest impact occurs between 11:00 - 19:00 hours. There is much less of an impact between 07:00 - 11:00 hours.
- The image **right below** shows *where* these scene arrivals are occurring more often (value > 0) or less often (value < 0). The largest impact is seen in the southeast area of Wales.





5.2 Scenario 2: merge Welshpool and Caernarfon

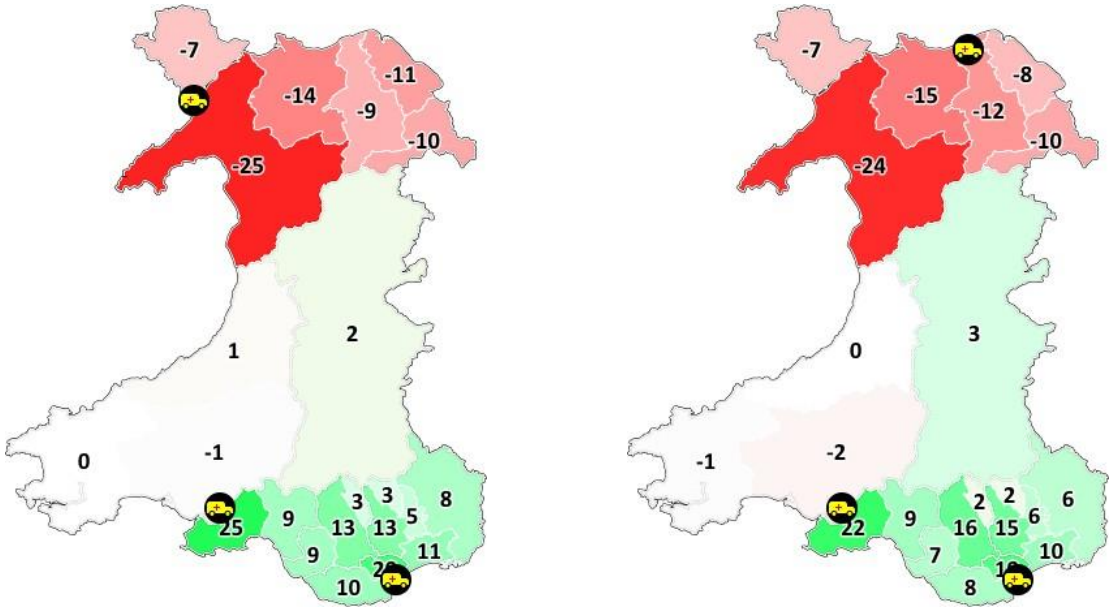
Scenario 2 explores four alternatives for merging the two crew shifts at Caernarfon and Welshpool into a single crew shift. **Scenario 2 builds on top of scenario 1**, so scenario 2 also contains a daily 07:00 - 19:00 crew shift at Cardiff Heliport. The table **below** adds the results from scenario 2 to the results table:

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21

Scenarios 2A - 2D contain the same number of crew hours as the Adjusted Baseline. Therefore:

- Scenarios 2A - 2D are slightly more effective than the Adjusted Baseline, because more dispatches and scene arrivals are occurring than in the Adjusted Baseline.
- Consequently, the utilisation in scenario 2A - 2D is also a bit higher (40% instead of 39%). The average response duration also improves by around 2 minutes (1h 03m instead of 1h 05m).

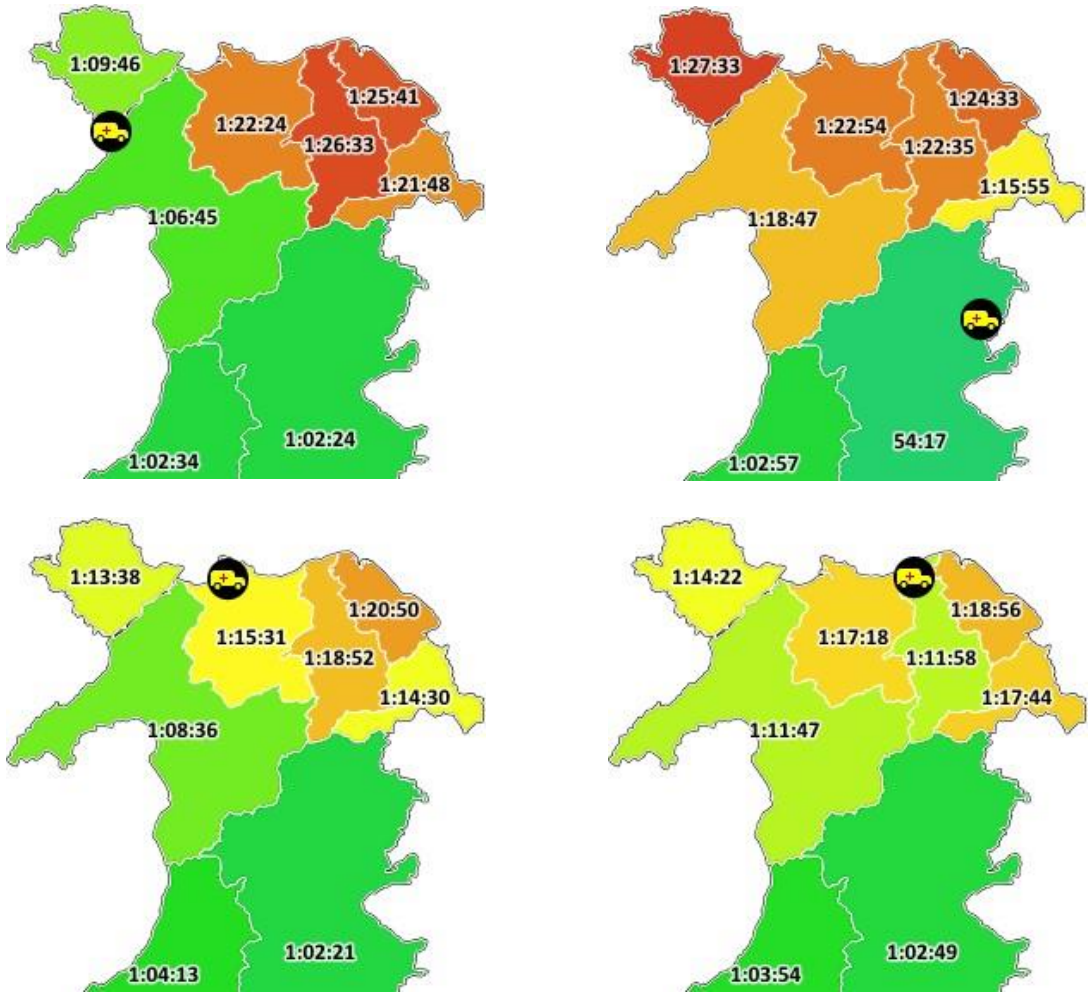
The images below show the difference in scene arrivals compared to the Adjusted Baseline. **Left** shows this for scenario 2A (merge into Caernarfon), **right** shows this for scenario 2D (merge into Denbighshire):



First, the images on the previous page show that the positioning of the north Wales crew shift has very little impact on how many and which incidents are responded to in north Wales. Scenarios 2A - 2D all have fewer scene arrivals compared to the Adjusted Baseline, but the amount and distribution are almost the same in all of these scenarios. Hence, the fewer scene arrivals in north Wales are primarily explained by poorer crew availability in the north. This is because there is only one crew shift working after the merger in scenario 2A - 2D, instead of two crew shifts in the Adjusted Baseline.

Second, the images also show why the increased number of scene arrivals in scenario 2A - 2D (2,791 - 2,802) is higher than in the Adjusted Baseline (2,743): it is primarily because of the extra daytime Cardiff crew shift, not because of the merger in north Wales or improved positioning in north Wales.

The geographical distribution of the average response duration by locality shows a bit more variation between scenarios 2A - 2D. This is shown in the images below. **Top left** is 2A (Caernarfon), **top right** is 2B (Welshpool), **bottom left** is 2C (Conwy), **bottom right** is 2D (Denbighshire).



On the assumption that all regions ideally should have the same average response duration, scenarios 2C (Conwy) and 2D (Denbighshire) perform better than 2A (Caernarfon) and 2B (Welshpool).

5.3 Scenario 3 (car): add a car-only crew shift to the merged base

Scenario 3 (car) builds on top of scenario 2, as follows:

- In scenario 1, a daily 07:00 - 19:00 crew shift (car / air) was added to Cardiff.
- Then, in scenario 2A - 2D, the crews in Caernarfon and Welshpool have been merged as 1 crew.
- Now, in scenario 3A - 3D, a second crew shift has been added to the merged base of scenario 2A - 2D. In this scenario, it is assumed that the second crew shift can only use a second car, not a second helicopter. In each scenario, the second shift is a daily 12-hour shift. Seven variations have been tested, by only adjusting the start time of the second crew as 08:00, 09:00, 10:00, 11:00, 12:00, 13:00 or 14:00 hours.

The table **below** shows that the number of scene arrivals depends on both the timing and the location. For each row, the highest value is marked in **green**. On the assumption that the highest number of scene arrival is the best, the best timing of the added shift is 14:00 - 02:00 hours. This applies to all variations of scenario 3 (car):

Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to the merged base at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
3A car) Caernarfon	2,829	2,843	2,867	2,866	2,889	2,891	2,903 (#)
3B car) Welshpool	2,811	2,821	2,830	2,835	2,849	2,856	2,857 (#)
3C car) Conwy	2,844	2,874	2,893	2,912	2,929	2,949	2,954 (#)
3D car) Denbighshire	2,843	2,872	2,905	2,912	2,931	2,947	2,960 (#)

The average response durations are also dependent on both timing and location. To achieve the shortest average response duration, the best locations are Conwy and Denbighshire, as shown in the table **below**. For each row, the lowest value is marked in **green**. The best timing is starting the shift around 14:00 hours (Conwy) or 13:00 hours (Denbighshire):

Response Duration (Average)	A daily, 12-hour car-only shift was added to the merged base at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
3A car) Caernarfon	1:02:24	1:01:19	1:01:29	1:01:03	1:01:01	1:00:23	1:00:07 (#)
3B car) Welshpool	1:02:33	1:02:28	1:02:15	1:02:19	1:01:48	1:01:51	1:01:33 (#)
3C car) Conwy	1:01:25	1:01:07	59:51	59:39	58:58	59:04	58:39 (#)
3D car) Denbighshire	1:01:13	1:00:49	1:00:46	59:43	58:57	58:32	58:41 (#)

To prevent an exponential growth in scenarios and simulation results, the Summary of Results table at the end of this report only reports on the best-performing variations in this section. These are the variations of scenarios 3C and 3D that are marked with an (**#**) in the table above.

5.4 Scenario 3 (air): add a car/air crew shift to the merged base

Scenario 3 (air) builds on top of scenario 3 (car) as follows:

- All things have been kept equal, except that the added crew shift can now choose between a 2nd car or a 2nd helicopter to respond to incidents. In scenario 3 (car) they were only able to pick a 2nd car.

The table **below** shows that the number of scene arrivals now primarily becomes dependent on the timing of the added shift, not on the location. For each row, the highest value is marked in **green**. Based on the same assumption as earlier, namely that higher is better, the best timing of the added shift is 14:00 - 02:00 hours for all scenario variations:

Scene Arrivals (Count)	A daily, 12-hour car/air shift was added to the merged base at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
3A air) Caernarfon	2,905	2,942	2,988	3,011	3,035	3,056	3,083 (#)
3B air) Welshpool	2,914	2,956	2,990	3,018	3,045	3,064	3,090 (#)
3C air) Conwy	2,907	2,945	2,977	2,996	3,030	3,055	3,073 (#)
3D air) Denbighshire	2,904	2,940	2,982	3,007	3,035	3,063	3,074 (#)

The average response durations show a similar pattern: they are affected more by timing, less by location. As shown in the table **below**, the best location and timing is Conwy, at 11:00 - 23:00 hours. For each row, the lowest value is marked in **green**:

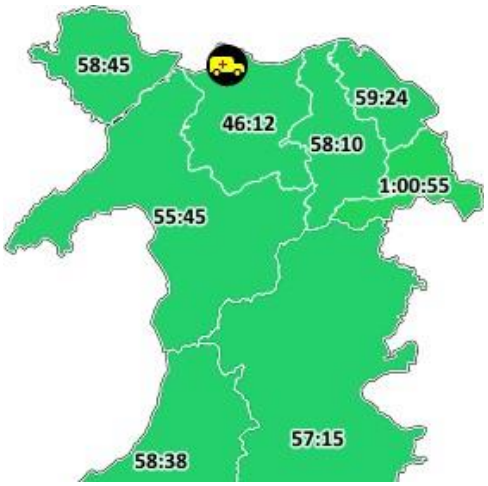
Response Duration (Average)	A daily, 12-hour car/air shift was added to the merged base at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
3A air) Caernarfon	59:45	59:35	58:49	59:07	57:08	57:11	57:17 (#)
3B air) Welshpool	1:00:05	59:29	58:43	57:47	57:16	57:20	57:27 (#)
3C air) Conwy	59:25	58:41	58:17	57:03	56:58	57:04	57:14 (#)
3D air) Denbighshire	59:21	58:40	58:37	57:48	57:37	56:55	56:40 (#)

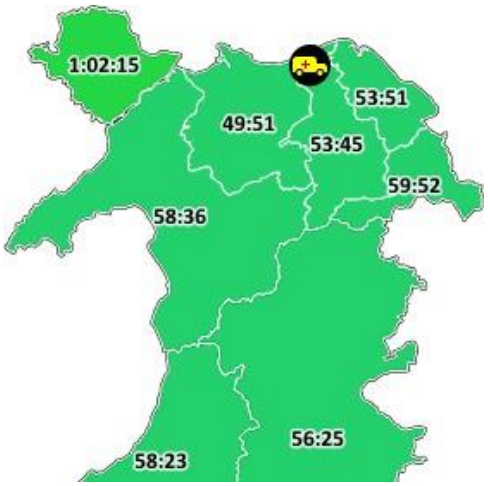
First, EMRTS has indicated that maximising the number of scene arrivals has a higher priority than achieving the shortest possible average response duration **(A)**. Second, the geographical analysis in scenario 2 showed that the most equal geographical distribution response duration is achieved when merging the two crews at Caernarfon and Welshpool into a single crew at Conwy or Denbighshire **(B)**.

When combining concepts (A) and (B), the conclusion is that the best performing variations of scenario 3 are 3C (Conwy) and 3D (Denbighshire), where an extra shift has been added at 14:00 hours. This applies to both Scenario 3 v1 and Scenario 3 v2. It is up to the service to decide whether the additional gains in scene arrivals and reductions in average response durations justify the cost of operating a second aircraft in the merged northern base.

Similar to before, the Summary of Results table at the end of this report only reports on the best- performing variations in this section. These are the variations that are marked with (**#**) above.

To confirm that the average response durations in scenario "3C air Conwy" (**left**) and scenario "3D air Denbighshire" (**right**) are still roughly equal by locality, see the images below. It can be seen that most areas have an average response duration below 1 hour in both scenarios and are reasonably equal by area:





The best-performing variations of Scenario 3 (car) and Scenario 3 (air) have been added to the overall results table **below**.

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21
Scenario 3 (car): then add a second 14h - 02h crew shift (car-only) to the merged base of scenario 2:					
3A car) Caernarfon	3,781	2,903	34%	1:00:07	26:35
3B car) Welshpool	3,737	2,857	34%	1:01:33	27:06
3C car) Conwy	3,834	2,954	34%	58:39	25:25
3D car) Denbighshire	3,840	2,960	34%	58:41	25:27
Scenario 3 (air): or allow the second 14h - 02h crew to also respond with a second helicopter:					
3A air) Caernarfon	3,964	3,083	36%	57:17	26:11
3B air) Welshpool	3,972	3,090	36%	57:27	26:27
3C air) Conwy	3,954	3,073	36%	57:14	25:38
3D air) Denbighshire	3,955	3,074	36%	56:40	25:50

The table above shows that, based on scene arrivals and response duration averages, the best- performing scenario so far is Scenario 3 (air).

5.5 Scenario 4 ("change"): change start time of the Cardiff 07h shift

Before, in scenario 3, the Cardiff base had two daily crew shifts:

- One daily daytime 12-hour crew shift, at 07:00 - 19:00 hours.
- One daily nighttime 12-hour crew shift, at 19:00 - 07:00 hours.

In this section, in Scenario 4 (change), the start time of the existing Cardiff 07:00 - 19:00 shift is varied as 07:00, 08:00, 09:00, 10:00, 11:00, 12:00, 13:00 or 14:00 hours.

Scenario 4 (change) builds on top of the best-performing variations of Scenario 3 (car):

- 4A) Conwy car + change Cardiff = 3C car (Conwy) + change existing daytime Cardiff shift.
- 4B) Denbighshire car + change Cardiff = 3D car (Denbighshire) + change existing daytime Cardiff shift.

The table **below** shows that the existing Cardiff daytime shift is best timed at 14:00 hours if maximising the number of scene arrivals is the only goal. For each row, the highest value is marked in **green**:

Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to Cardiff at:							
	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4A) Conwy car + change Cardiff	2,989	3,020	3,049	3,076	3,113	3,127	3,147	3,147 (#)
4B) Denbighshire car + change Cardiff	2,993	3,028	3,059	3,088	3,111	3,133	3,152	3,153 (#)

However, the table **below** shows that the shortest average response duration is achieved by having the existing Cardiff daytime shift work from around 10:00 hours. For each row, the lowest value is marked in **green**:

Response Duration (Average)	A daily, 12-hour car-only shift was added to Cardiff at:							
	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4A) Conwy car + change Cardiff	57:42	57:32	57:04	57:15	57:09	57:28	58:17	58:53 (#)
4B) Denbighshire car + change Cardiff	57:50	57:44	57:22	57:00	57:03	57:36	58:09	58:33 (#)

The results summary table at the end of this report shows the 'best-performing scenario variations'. It is assumed that maximising the number of scene arrivals is leading here (start at 14:00 hours), even though the average response duration is the slowest when starting at 14:00 hours.

The Summary of Results table near the end of this report only reports on the variations marked with (**#**).

5.6 Scenario 4 ("car"): add a car-only crew shift to the Cardiff base

In this scenario, the daily daytime Cardiff crew shift is reverted to its default settings (= 07:00 - 19:00 hours). Instead, in Scenario 4 (car), an additional car-only crew is added to Cardiff.

Scenario 4 (car) builds on top of the best-performing variations of Scenario 3 (car):

- Conwy car + Cardiff car = 3C car (Conwy) + car-only shift at Cardiff.
- Denbighshire car + Cardiff car = 3D car (Denbighshire) + car-only shift at Cardiff.

The table **below** shows that the additional Cardiff car crew shift is best timed at 14:00 hours. For each row, the highest value is marked in **green**:

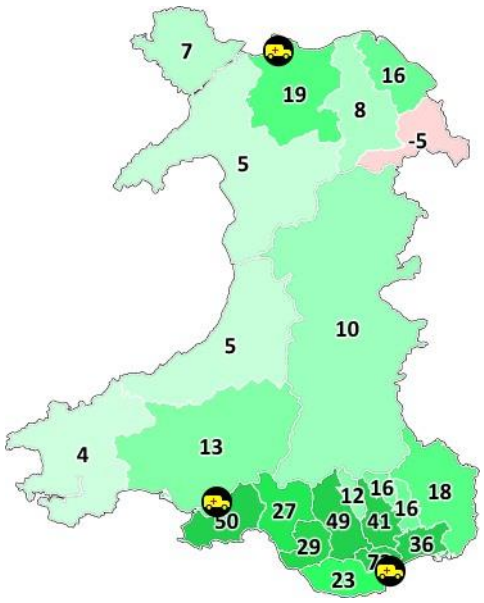
Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4A) Conwy car + Cardiff car	3,054	3,090	3,127	3,159	3,189	3,202	3,217 (#)
4B) Denbighshire car + Cardiff car	3,061	3,102	3,135	3,163	3,185	3,210	3,229 (#)

As shown **below**, to achieve the shortest average response duration, the additional Cardiff car crew shift is best timed to begin in the early afternoon. For each row, the lowest value is marked in **green**:

Response Duration (Average)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4A) Conwy car + Cardiff car	55:28	55:19	55:07	54:58	54:36	54:34	54:13 (#)
4B) Denbighshire car + Cardiff car	55:35	54:49	54:50	54:38	54:33	54:27	54:35 (#)

The Summary of Results table near the end of this report only reports on the variations marked with (**#**).

This section contains the two best-performing scenarios in this report. The images below show how the number of scene arrivals has changed compared to the Adjusted Baseline. **Left** shows this for scenario "4A Conwy car + Cardiff car (#)". **Right** shows this for "4B Denbighshire car + Cardiff car (#)":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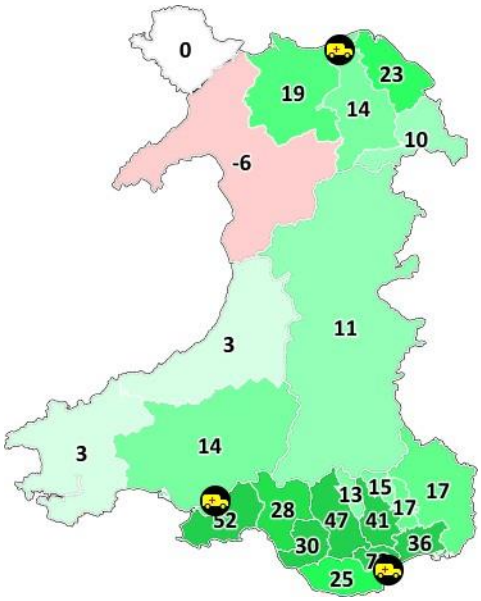
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25

The scenarios in this report have shown that operating from Conwy or Denbighshire leads to very similar performance. CSAM Optima has been informed that, because of this similar performance, this makes Denbighshire is the preferred scenario. This is because there are existing operation facilities at Denbighshire, whereas there is currently nothing at Conwy.

For this preferred scenario, the table **below** shows the number of dispatches, number of scene arrivals, average response duration in minutes, and average vehicle reflex duration in minutes, split by locality:

Scenario 4B (car): Denbighshire car at 14:00 hours + Cardiff car at 14:00 hours.				
Locality	**Dispatches (count)**	**Scene Arrivals (count)**	**Response Duration (avg, minutes)**	**Veh. Reflex Duration (avg, minutes)**
Blaenau Gwent	101	70	58	26
Bridgend	174	137	54	21
Caerphilly	202	150	53	22
Cardiff	424	332	44	14
Carmarthenshire	268	212	51	25
Ceredigion	99	75	63	38
Conwy	163	130	48	22
Denbighshire	133	106	55	22
Flintshire	163	125	54	25
Gwynedd	256	216	66	35
Isle of Anglesey	110	91	75	40
Merthyr Tydfil	87	69	56	23
Monmouthshire	113	85	59	27
Neath Port Talbot	183	137	55	23
Newport	191	146	48	19
Pembrokeshire	148	112	70	41
Powys	268	227	60	37
Rhondda Cynon Taf	294	220	49	21
Swansea	338	276	54	24
The Vale Of Glamorgan	147	115	41	17
Torfaen	93	75	54	21
Wrexham	156	123	62	31

5.7 Summary of best-performing scenario variations

The table **below** shows a summary of the best-performing scenario variations for Scenarios 1 up to 4. All of these have been discussed in the previous sections.

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21
Scenario 3 (car): then add a second 14h - 02h crew shift (car-only) to the merged base of scenario 2:					
3A car) Caernarfon	3,781	2,903	34%	1:00:07	26:35
3B car) Welshpool	3,737	2,857	34%	1:01:33	27:06
3C car) Conwy	3,834	2,954	34%	58:39	25:25
3D car) Denbighshire	3,840	2,960	34%	58:41	25:27
Scenario 3 (air): or allow the second 14h - 02h crew to also respond with a second helicopter:					
3A air) Caernarfon	3,964	3,083	36%	57:17	26:11
3B air) Welshpool	3,972	3,090	36%	57:27	26:27
3C air) Conwy	3,954	3,073	36%	57:14	25:38
3D air) Denbighshire	3,955	3,074	36%	56:40	25:50
Scenario 4 (“change”): continuing on scenario 3C/3D (car), change start time of Cardiff day shift to 14h:					
4A) Conwy car + change Cardiff	4,027	3,147	37%	58:53 **	26:24
4B) Denbighshire car + change Cardiff	4,034	3,153	37%	58:33 **	26:30
Scenario 4 (“car”): continuing on scenario 3C/3D (car), add a 14h - 02 crew shift (car-only) to Cardiff:					
4A) Conwy car + Cardiff car [#]	4,099	3,217	32%	54:13	25:04
4B) Denbighshire car + Cardiff car [#]	4,110	3,229	32%	54:35	25:16
** = The maximum number of scene arrivals in scenario 4 (change) is achieved by changing the Cardiff daytime shift to 14:00 hours. However, faster average response durations are achieved when changing the start time to 10:00 hours.					

6 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

As shown in the Methodology chapter, most of the unmet need occurs in the evenings. Hence, most of the scenarios show the strongest increase in the number of scene arrivals when shifts are moved to evenings or when new shifts are placed in the evenings.

This report has discussed a large number of variations of merging bases, moving shifts or adding shifts. It is up to the service what the balance is between maximising the number of scene arrivals, (cost-) effectiveness, and efficiency:

- Merging Caernarfon and Welshpool is best done into Conwy or Denbighshire. Both options lead to a very similar number of scene arrivals and (geographical distribution of) response durations.
- As a rule of thumb, the strongest increases in the number of scene arrivals are seen when moving/adding shifts so that they start at 14:00 hours. However, they don't always lead to the fastest average response durations.
- The best performing scenarios in this report are those where Caernarfon and Welshpool are merged into either Conwy or Denbighshire (scenarios 2C and 2D); then adding a second car-only crew to the merged base at 14:00 hours (scenarios 3C and 3D); then adding a car-only crew to Cardiff at 14:00 hours (scenario 4 (car) 4A and 4B). This increases the number of simulated scene arrivals from 2,743 to 3,217 - 3,229. It decreases the simulated average response duration from 1:05:35 minutes to 54:13 - 54:35 minutes. The simulated average vehicle reflex duration is decreased from 27:36 minutes to 25:04 - 25:16 minutes.
- The combination of adding a second helicopter for the extra crew at Conwy/Denbighshire + adding a car-only crew to Cardiff has not yet been explored. This can be done in follow-up modelling. This will very likely be an even better performing scenario, as it provides an additional helicopter to the merged base in north Wales.

6.2 Recommendations

CSAM Optima recommends that EMRTS discusses this report thoroughly with all relevant stakeholders.

The figures in this report have been presented as absolute values to provide greater clarity and transparency. However, all figures, especially the number of scene arrivals, are highly dependent on the "incident abandonment logic", as explained in the Methodology chapter. Hence, CSAM Optima strongly recommends interpreting figures as relative differences (e.g. a 200 increase per year instead of 2,800 and 3,000).

CSAM Optima welcomes any follow-up questions, requests to model any unexplored options, or to re- run existing scenarios based on new insights or new assumptions.

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UNMET NEED SCENARIOS: SCENARIOS

05 - 10

EMERGENCY MEDICAL RETRIEVAL AND TRANSFER SERVICE

Version 4.0 (**Final Version**) 28 July 2022

Created by: Tef Jansma Optima Predict version: 22.4.0.54394

To protect the environment, please do not print this document unless necessary.

EXECUTIVE SUMMARY

Recap of scenarios 1 – 4 (see previous report for details):

This report is a follow-up of *'EMRTS Unmet Need Scenarios 01 - 04.pdf', 28 May 2022, Tef Jansma*. That report covers the following four scenarios:

Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport. **Scenario 2:** then merge the two crews of Welshpool and Caernarfon into one crew at Caernarfon, Welshpool, Conwy or Denbighshire.

Scenario 3:

- Option 1, "Scenario 3 (car)": add a second crew shift (car-only) to the merged base of scenario 2.
    - **Sensitivity modelling on scenario 3 has been done, see the end of this report.**
- Option 2, "Scenario 3 (air)": or allow the second crew to also respond with a second helicopter.

Scenario 4:

- Option 1, "Scenario 4 (change)": based on scenario 3 (car), change the start time of the existing Cardiff day crew.
- Option 2, "Scenario 4 (car): based on scenario 3 (car), add a second Cardiff day crew (car-only).

The best performing scenarios in that report are those where Caernarfon and Welshpool are merged into either Conwy or Denbighshire (scenarios 2C and 2D); then adding a second car-only crew to the merged base at 14:00 hours (scenarios 3C and 3D); then adding a car-only crew to Cardiff at 14:00 hours (scenario 4 (car) 4A and 4B). This increases the number of simulated scene arrivals from 2,743 to 3,217
- 3,229. It decreases the simulated average response duration from 1:05:35 minutes to 54:13 - 54:35 minutes. The simulated average vehicle reflex duration is decreased from 27:36 minutes to 25:04 - 25:16 minutes.

CSAM Optima strongly recommends reading the original report with scenarios 1 - 4 in full before reading this report. This is because scenarios 5 - 9 in this report continue on top of these earlier scenarios.

A summary table of the simulation results for all scenarios (1 – 10) can be found near the end of this report, in section 3.6 (Summary of scenarios 1 - 10).

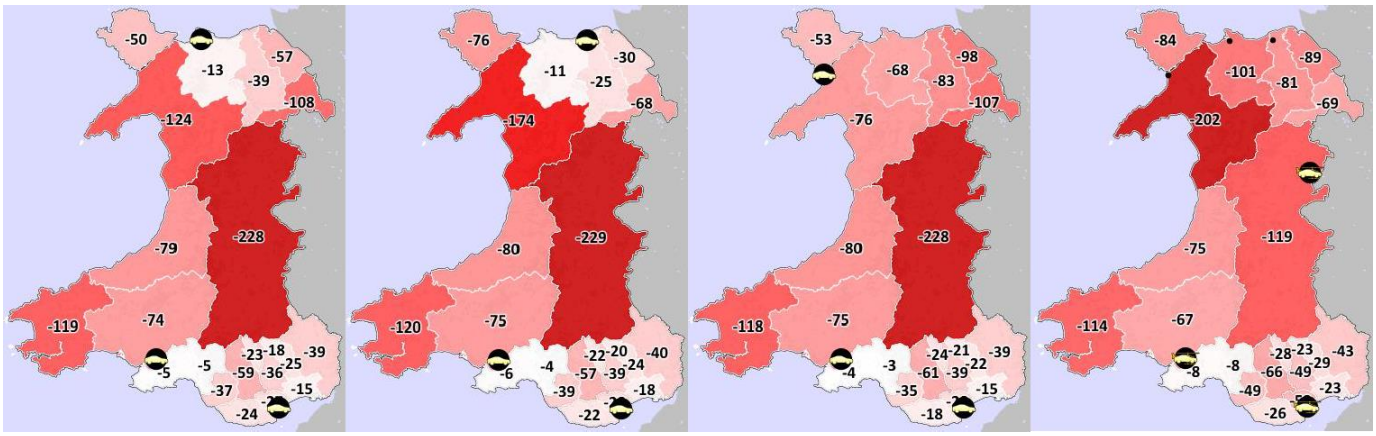
Summary of scenarios 5 - 10:

Scenario 5 is an adjusted version of scenario 4B ("car"). In scenario 5, the 14:00 shift at Denbighshire is a car/helicopter shift, instead of car-only. This leads to an increase of about 100 extra scene arrivals. It does not lead to a significant change in average response durations or average vehicle reflex durations.

Scenario 6 has shown that, if the helicopter in Denbighshire for the 14:00 shift would only be available 6 months of the year, the best timing is from April to September. The other 6 months of the year the Denbighshire 14:00 shift operates as a car-only shift. The number of scene arrivals and response durations of scenario 6 is in between those of scenarios 4B and 5. The April-September variation shows the highest count of scene arrivals. The overall average response durations seem less dependent on the timing.

Scenario 7 takes it another step further, by restricting the flying times of some, or all of the helicopters in scenarios 4B, 5 and 6 by daylight hours. In all variations of scenario 7, there is a reduction in scene arrivals. The strongest impact is seen in the middle of Wales (Powys, Hywel Dda), as the cars are much less likely to drive long distances from Cardiff, Dafen or Denbighshire. Time-wise, the strongest decrease in scene arrivals occurs in the late evenings and nights. This is also when the response durations improve the most, as longer trips through helicopters are "avoided" by not flying outside daylight hours.

Scenario 8 contains variations of scenario 4 ("change"), with all shifts being car-only, to simulate permanent poor weather. This shows a strong reduction in the number of scene arrivals and utilisation. The average response durations and average vehicle reflex durations are less affected. The images below show how the count of scene arrivals has changed by locality. These are the changes from scenario 8A compared to 4A (Conwy), from 8B compared to 4B (Denbighshire), from 8C compared to 4C (Caernarfon), and from 8D compared to 4D (Welshpool), **from left to right** respectively:



Scenario 9 contains variations of scenario 4 ("car"), with all shifts being car-only, to simulate permanent poor weather. The impacts are very similar to scenario 8: reduced scene arrivals and utilisation, but little impact on response durations. Due to scenario 9 having three shifts in Cardiff (07h, 14h, 19h) instead of two in scenario 8 (14h+19h), scenario 9 has ~170 more scene arrivals per year than scenario 8.

Scenario 10 uses the configuration of Scenario 1, but with an extra 12h car-only shift. The best placement out of Caernarfon, Welshpool, Denbighshire, and Ruthin is an extra 14h-02h car shift in Denbighshire.

CONTENTS

GLOSSARY

The following abbreviations and terms are used in this report:

Abbreviation	Description
EMRTS	Emergency Medical Retrieval and Transfer Service
CSAM Optima Predict	Advanced simulation modelling software from CSAM Optima
H57, H59, H61, H67	Callsigns (car/helicopter names)
WAST	Welsh Ambulance Service Trust

1 INTRODUCTION

CSAM Optima strongly recommends reading the original report with scenarios 1 - 4 in full before reading this report. This is because scenarios 5 - 9 in this report continue on top of these earlier scenarios, in particular scenario 4 ("change") and scenario 4 ("car"). For this reason, the key results of scenario 4 have been repeated a few times in this report. For results of scenarios 1 - 3, see the

Scenarios 5 - 9 in this report are as follows:

Scenario 5: this scenario is similar to 'Scenario 4B Denbighshire car + Cardiff car. The only difference is that the Denbighshire car-only shift has been replaced by a Denbighshire car/helicopter shift.
Scenario 6: based on scenario 5, what would be the best six months of the year for the second crew to have access to a second helicopter in Denbighshire? It is assumed that the second Denbighshire crew is car- only during the other six months.
Scenario 7: these are variations of scenarios 4B, 5, and 6, with limited aircraft availability, as shown in the table below. Outside these hours, crews are still available to respond by car:

Abbreviation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aircraft start time	08:00	08:00	07:00	07:00	06:00	05:00	05:00	05:00	06:00	07:00	07:00	08:00
Aircraft end time	17:00	18:00	20:00	21:00	22:00	22:00	22:00	21:00	19:00	18:00	16:00	16:00

Scenario 8: poor weather scenarios with 2 shifts at Cardiff. Assume a car-only response from Cardiff (daily 12h shifts at 14:00 and 19:00 hours), and Dafen (daily 12h shift at 07:00 hours). Then, assess the impact of having only a daily 12h car-only shift from either Denbighshire, Conwy, Caernarfon, or Welshpool.

Scenario 9 contains variations of scenario 4 ("car"), with all shifts being car-only, to simulate permanent poor weather. The impacts are very similar to scenario 8: reduced scene arrivals and utilisation, but little impact on response durations. Due to scenario 9 having three shifts in Cardiff (07h, 14h, 19h) instead of two in scenario 8 (14h+19h), scenario 9 has ~170 more scene arrivals per year than scenario 8.

Scenario 10 uses the configuration of Scenario 1, but with an extra 12h car-only shift. The best placement out of Caernarfon, Welshpool, Denbighshire, and Ruthin is an extra 14h-02h car shift in Denbighshire.

2 METHODOLOGY

This report does not have a distinctly new methodology or approach compared to the previous report (*'EMRTS Unmet Need Scenarios 01 - 04.pdf', 28 May 2022, Tef Jansma*). It continues to build upon scenario 4 ("change") and scenario ("car") from that report.

Please review the Methodology section in the previous report for more details about the used incident and response data, the development of the baseline model, and data cleaning and adjustments before simulations. It also explains the 'incident abandonment logic', which determines when calls are never responded to. Finally, it states certain assumptions and limitations.

3 SIMULATION RESULTS

3.1 Scenario 5: Denbighshire air + Cardiff car

Scenario 5 uses the following shifts:

- Dafen: daily 12h car/helicopter shift at 07:00 hours.
- Denbighshire: daily 12h car/helicopter shifts at 08:00 and 14:00 hours
- Cardiff: daily 12h car/helicopter shifts at 07:00 and 19:00 hours + extra car-only shift at Cardiff.

Scenario 5 is similar to 'Scenario 4B Denbighshire car + Cardiff car'. The only difference is that the Denbighshire car-only shift has been replaced by a Denbighshire car/helicopter shift.

In this scenario, it is assumed that all car/helicopter shifts can respond by helicopter for the entire duration of the shift. This also applies to the 14:00 Denbighshire car/helicopter shift. This is to enable a like- for-like comparison to scenario 4B. In scenario 7, restrictions on helicopter flight times by hour of day have been applied.

The tables **below** show the count of scene arrivals and the average response duration, for various start times of the extra car-only shift at Cardiff:

Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4B) Denbighshire car + Cardiff car	3,061	3,102	3,135	3,163	3,185	3,210	3,229
5) Denbighshire air + Cardiff car	3,171	3,203	3,234	3,264	3,284	3,307	3,320 (#)

Response Duration (Average)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
4B) Denbighshire car + Cardiff car	55:35	54:49	54:50	54:38	54:33	54:27	54:35
5) Denbighshire air + Cardiff car	54:26	54:11	53:53	53:24	53:25	53:09	53:16 (#)

On the assumption that the number of scene arrivals is the most important criterion, the variation of scenario 5 with the extra car-only shift in Cardiff at 14:00 hours is the best-performing scenario. This is very similar to earlier findings, which also identified 14:00 hours as the best time. It has been marked with (**#**) above. The other performance metrics of this scenario variation are shown in the table **below**:

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 4B: the best-performing scenario of the previous report. Review the Introduction for more details.					
4B) Denbighshire car + Cardiff car	4,110	3,229	32%	54:35	25:16
Scenario 5: similar to scenario 4B ("car"), but the 14:00 shift at Denbighshire is car/helicopter, instead of car-only.					
5) Denbighshire air + Cardiff car	4,203	3,320	33%	53:16	25:29

3.2 Scenario 6: Denbighshire air (6 months) + Cardiff car

Based on scenario 5, what would be the best six months of the year to operate the second helicopter in Denbighshire? It is assumed that the second Denbighshire crew is car-only during the other six months. This scenario continues on the best-performing variation of scenario 5: this is where the extra car-only shift has been added to Cardiff at 14:00 hours.

Scenario 6 uses the following shifts:

- Dafen: daily 12h car/helicopter shift at 07:00 hours.
- Denbighshire: daily 12h car/helicopter shifts at 08:00 hours.

There is also a daily 12-h car/helicopter shift at Denbighshire at 14:00 hours, but this shift operates only for six months in the year. The other six months this shift is car-only.

- Cardiff: daily 12h car/helicopter shifts at 07:00, 14:00 and 19:00 hours.

Similar to all earlier scenarios, scenario 6 assumes that helicopters can be used at any time of day.

This means that scenario 6 is a hybrid of scenario 4B (where the 14:00 Denbighshire shift is fully car-only) and scenario 5 (where the 14:00 Denbighshire shift is fully car/helicopter). The count of scene arrivals for scenarios 4B, 5 and 6 are shown **below**:

Scene Arrivals (Count)	**In scenario 6, the 14:00 shift at Denbighshire was helicopter-enabled during:**					
4B) Denbighshire car + Cardiff car	3,229					
5) Denbighshire air + Cardiff car	3,320					
6) Denbighshire air (6 months) + Cardiff car	Jan-Jun	Feb-Jul	Mar-Aug	Apr-Sep	May-Oct	Jun-Nov
	3,275	3,285	3,285	3,293 (#)	3,285	3,287
	Jul-Dec	Aug-Jan	Sep-Feb	Oct-Mar	Nov-Apr	Dec-May
	3,273	3,276	3,265	3,252	3,263	3,266

The results above show two things:

- The count of scene arrivals for all variations of scenario 6 is in between scenarios 4B and 5. This is as expected, because scenario 6 (the 2nd helicopter in Denbighshire operates 6 months of the year) is a hybrid of scenario 4B (the 2nd helicopter in Denbighshire operates 12 months of the year) and scenario 5 (2nd helicopter in Denbighshire operates 0 months of the year). All other shifts in scenarios 4B, 5 and 6 are equal.
- The best six months of the year for the Denbighshire shift to operate as a car/helicopter shift is April until September, as this scenario variation has the highest count of scene arrivals. This scenario is marked with (**#**) above.

The table **below** shows the simulated average response durations for scenarios 4B, 5 and 6:

Response Duration (average)	**For scenario 6, the 14:00 shift at Denbighshire was car-only, except during:**					
4B) Denbighshire car + Cardiff car	54:35					
5) Denbighshire air + Cardiff car	53:16					
6) Denbighshire air (6 months) + Cardiff car	Jan-Jun	Feb-Jul	Mar-Aug	Apr-Sep	May-Oct	Jun-Nov
	53:39	54:01	53:37	54:07 (#)	53:49	54:05
	Jul-Dec	Aug-Jan	Sep-Feb	Oct-Mar	Nov-Apr	Dec-May
	53:42	54:05	53:58	53:53	53:53	54:17

Similar to above, the response durations of scenario 6 are in between those of scenarios 4B and 5. However, there is not a conclusive pattern (e.g. summer is better than winter) about which period of the year leads to the fastest average response duration. Based on results in scenario 7, this is likely due to different response profiles (e.g. travel distance and mobilisation speed) of helicopters versus cars, which may lead to counterintuitive results.

The scenario variation with the highest count of scene arrivals is considered to be the best-performing scenario. This is the variation where the 14:00 Denbighshire shift operates as a car/helicopter shift from April until September. This scenario has been marked with (**#**) above.

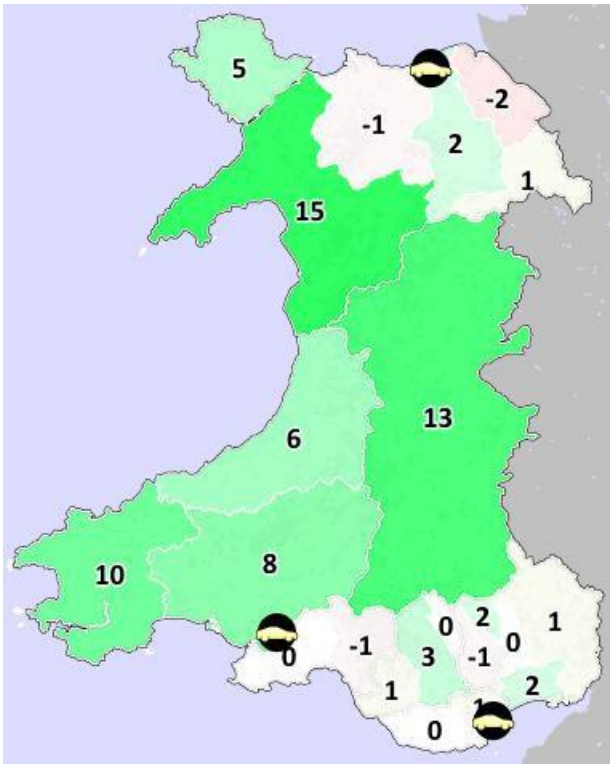
The table **below** adds the results of scenario 6 to those of scenarios 4B and 5:

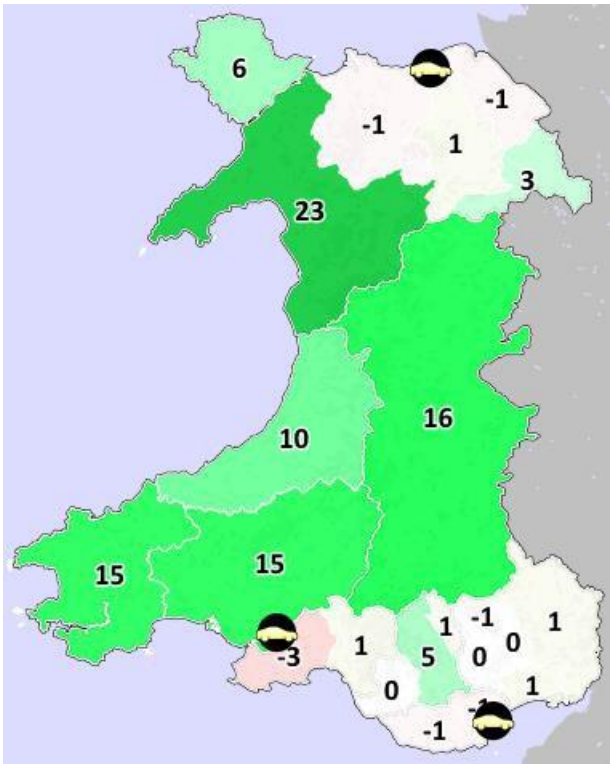
Scenario	**Dispatches**	**Scene Arrivals**	**Crew Utilisation**	**Response Duration (avg)**	**Veh. Reflex Duration (avg)**
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 4B: the best-performing scenario of the previous report. Review the Introduction for more details.					
4B) Denbighshire car + Cardiff car	4,110	3,229	32%	54:35	25:16
Scenario 5: similar to scenario 4B (“car”), but the 14:00 shift at Denbighshire is car/helicopter, instead of car-only.					
5) Denbighshire air + Cardiff car	4,203	3,320	33%	53:16	25:29
Scenario 6: a hybrid of 4B (“car”) and 5. The Denbighshire 14:00 shift is car-only, except from April until September:					
6) Denbighshire air (6mo) + Cardiff car	4,174	3,293	32%	54:07	25:22

Consider the table **below**, which shows how the number of scene arrivals increases from scenario 4B to scenario 6 to scenario 5:

Scenario	Scenario 4B	Scenario 6	Scenario 5
Modelled helicopter availability for the Denbighshire 14:00 shift:	Never	Apr - Oct 14:00 – 02:00 (6 months of the year)	Jan - Dec 14:00 – 02:00 (all months of the year)
Number of Scene Arrivals	3,229	3,293 (**+64** compared to 4B)	3,320 (**+91** compared to 4B)

The images below show how the number of scene arrivals has changed in scenario 6 compared to scenario 4B (**left**) and in scenario 5 compared to scenario 4B (**right**):





This shows that the change in scene arrivals is mainly noticeable in areas that are the furthest away from Cardiff, Dafen and Denbighshire. This can be explained by cars being less likely to drive long distances to respond in scenario 6 and 5, compared to the helicopter responses in scenario 4B.

3.3 Scenario 7: daylight helicopters only

These are variations of scenarios 4B, 5, and 6, with limited aircraft availability as shown below. Outside these hours, crews are still available to respond by car:

Abbreviation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aircraft start time	08:00	08:00	07:00	07:00	06:00	05:00	05:00	05:00	06:00	07:00	07:00	08:00
Aircraft end time	17:00	18:00	20:00	21:00	22:00	22:00	22:00	21:00	19:00	18:00	16:00	16:00

Each scenario (4B, 5 and 6) has been re-modelled in two versions, as follows:

- In the first version, the daylight restrictions have been applied to all shifts, except for the H67 shifts. Hence, the H67 from Cardiff was assumed to be able to respond by helicopter 24/7.
- In the second version, the daylight restrictions have been applied to all shifts, including the H67 shifts. Hence, none of the helicopters within Wales were able to respond outside daylight hours.

The results are shown in the table **below**:

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 4B: the best-performing scenario of the previous report. Review the Introduction for more details.					
4B) Denbighshire car + Cardiff car	4,110	3,229	32%	54:35	25:16
Scenario 5: similar to scenario 4B ("car"), but the 14:00 shift at Denbighshire is car/helicopter, instead of car-only.					
5) Denbighshire air + Cardiff car	4,203	3,320	33%	53:16	25:29
Scenario 6: a hybrid of 4B ("car") and 5. The Denbighshire 14:00 shift is car-only, except from April until September:					
6) Denbighshire air (6mo) + Cardiff car	4,174	3,293	32%	54:07	25:22
Scenario 7: helicopters can fly during daylight only. These are variations of scenarios 4B, 5 and 6 above.					
7-4Bv1) Not applied to H67	4,079	3,198	31%	55:07	25:13
7-4Bv2) Applied to all shifts	3,937	3,056	30%	52:06	23:15
7-5v1) Not applied to H67	4,136	3,254	32%	53:34	25:04
7-5v2) Applied to all shifts	3,987	3,107	30%	51:21	23:17
7-6v1) Not applied to H67	4,127	3,247	31%	53:57	25:00
7-6v2) Applied to all shifts	3,985	3,105	30%	51:32	23:18

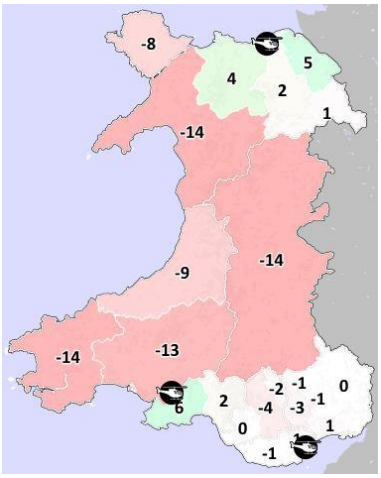
These results show the following:

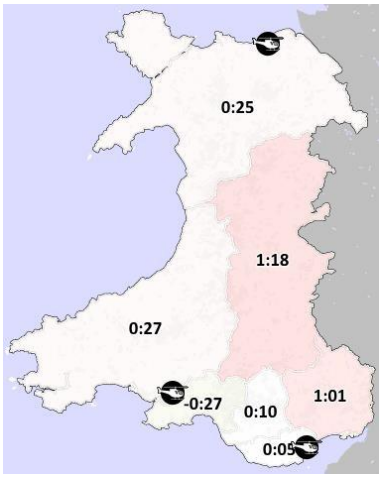
- The scene arrivals of the three variations of scenario 5 are as follows:
    - Scenario 5 has a 14:00 Denbighshire car/helicopter shift. All fly 24/7:3,320 scene arrivals.
    - In scenario 7-5v1, the H67 helicopter can fly 24/7, others cannot: 3,254 scene arrivals.
    - In scenario 7-5v2, all helicopters can only fly during daylight: 3,107 scene arrivals.

  This shows that the number of scene arrivals in scenario 5 decreases as fewer helicopters have fewer opportunities to fly during daylight hours. The pattern also applies to scenarios 4B and 6.

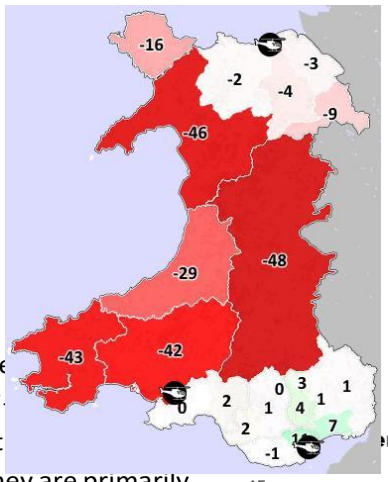
- The average response durations and vehicle reflex durations are faster when none of the helicopters can fly outside daylight hours (the 'v2' scenarios compared to 'v1'). As suggested above and explained below, this is likely due to the cars mobilising faster and having a smaller range compared to helicopters. However, the faster response durations do come at a cost: fewer scene arrivals.

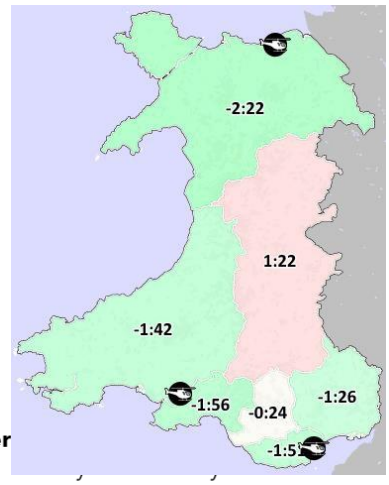
Consider the top two images on the right. They show how scenario 7-5v1 is different to scenario 5. Recall that scenario 5 has a 14:00 shift in Denbighshire that can respond by car or helicopter. In scenario 7-5v1, all car/helicopter shifts are restricted by daylight hours, except the H67 in Cardiff (24/7). The **top left** image shows that the count of scene arrivals goes down slightly, mainly in mid and north Wales. The **top right** image shows that the average vehicle reflex duration is only slightly affected.



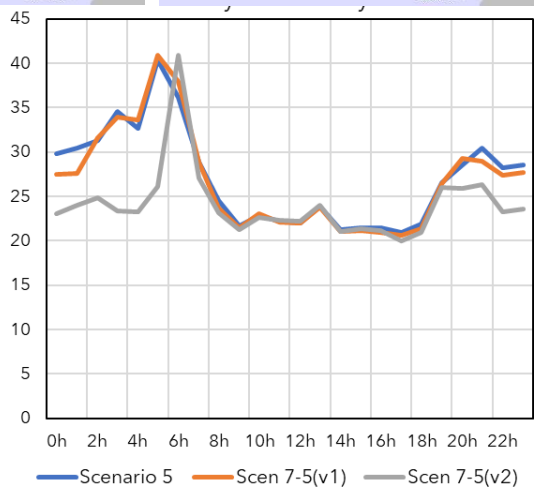


The bottom two images show the same metrics, but now for scenario 7- 5v2 compared to scenario 5. In scenario 7-5v2, all helicopters in Wales are restricted by daylight hours. The **bottom left** image shows a strong reduction in scene arrivals in mid and north Wales. Similarly, the **bottom right** image shows a stronger reduction in average vehicle reflex durations.





The chart at the **right** shows that the average durations are only affected slightly in scenario 7- in scenario 7-5v2, they are faster, but only at night a similar pattern for the count of scene arrivals: they are primarily lower at night, especially in scenario 7-5v2.



Hence, the average vehicle reflex durations in the "v2" scenarios are primarily faster because the model "avoids" long response durations by not sending a car to certain incidents. These are incidents that otherwise would have been responded to by helicopter.

3.4 Scenario 8: poor weather (with 2 shifts in Cardiff)

This scenario assumes car-only responses from all shifts. The following shifts are in Cardiff and Dafen:

- Cardiff: daily 12h shifts at 14:00 and 19:00 hours.
- Dafen: daily 12h shift at 07:00 hours

Then, assess the impact of having only a daily 12h car-only shift at:

- Scenario 8A) …Conwy: daily 12-hour shifts at 08:00 and 14:00 hours.
- Scenario 8B) …or Denbighshire: daily 12-hour shifts at 08:00 and 14:00 hours.
- Scenario 8C) …or Caernarfon: daily 12-hour shifts at 08:00 and 14:00 hours.
- Scenario 8D) …or Welshpool: daily 12-hour shifts at 08:00 and 14:00 hours.

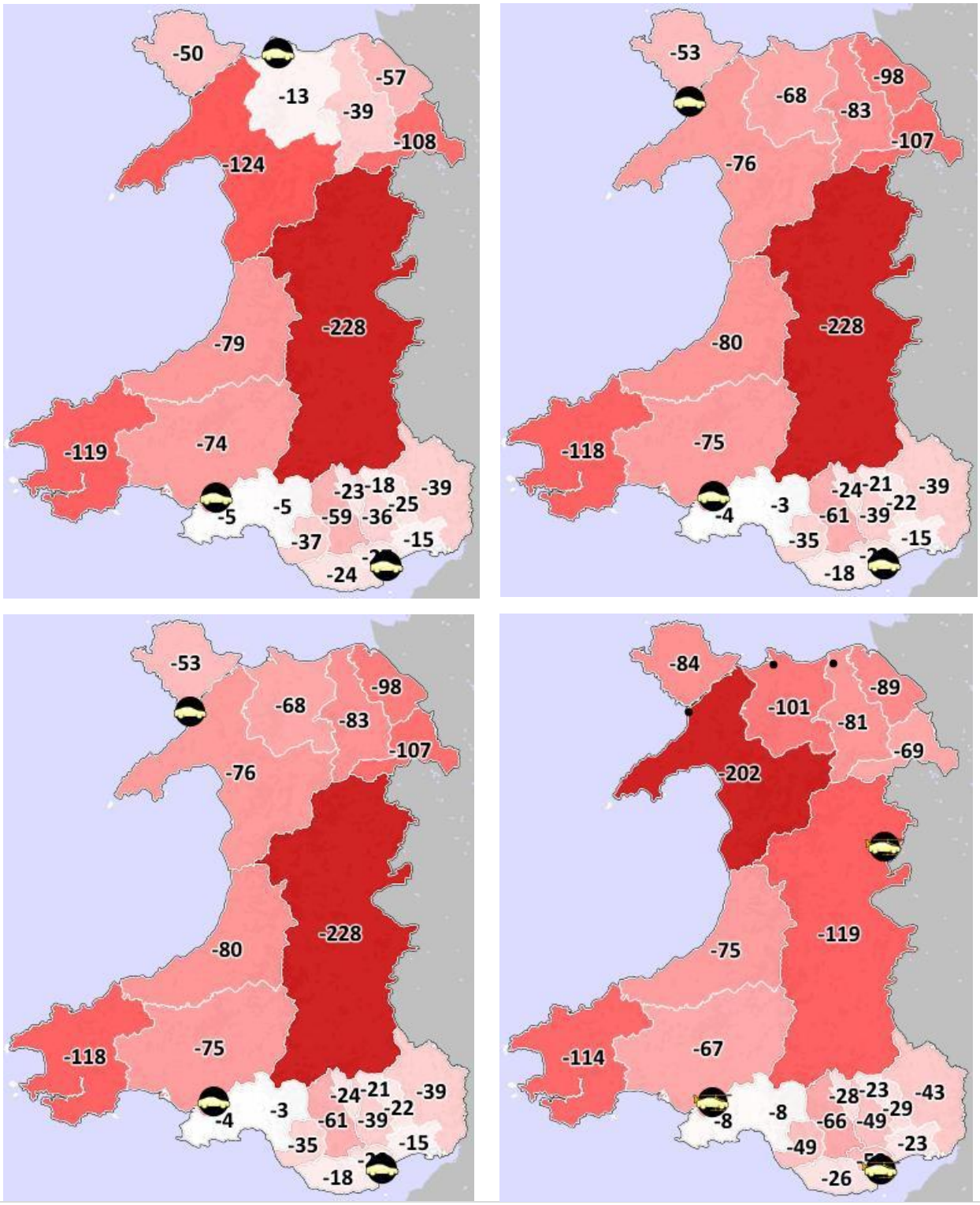
Please note that:

- Scenario 8A, the Conwy variation, is the car-only equivalent of *"Scenario 4 ("change") - 4A) Conwy car + change Cardiff"* from the previous report.
- Scenario 8B, the Denbighshire variation is the car-only equivalent *of "Scenario 4 ("change") - 4B) Denbighshire car + change Cardiff"* in the previous report.
- A non-car equivalent of scenario 8C (merge into Caernarfon) has also been added to the table below (scenario 4C). This is to enable comparisons from scenario 4C to scenario 8C.
- A non-car equivalent of scenario 8D (merge into Welshpool) has also been added to the table below (scenario 4D). This is to enable comparisons from scenario 4D to scenario 8D.

The results of scenarios 8A, 8B, 8C and 8D are shown in the table **below**:

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 4 ("change"): 4A and 4B from the previous report. Review the previous report for the full description.					
***4A)** Conwy car + change Cardiff*	*4,027*	*3,147*	*37%*	*58:53*	*26:24*
***4B)** Denbighshire car + change Cardiff*	*4,034*	*3,153*	*37%*	*58:33*	*26:30*
***4C)** Caernarfon car +change Cardiff (new, for comparing with 8C)*	*3,985*	*3,104*	*37%*	*59:45*	*27:20*
***4D)** Welshpool car +change Cardiff (new, for comparing with 8D)*	*3,954*	*3,073*	*36%*	*1:02:07*	*28:06*
Scenario 8: poor weather (with 2 shifts in Cardiff, at 14:00 and 19:00 hours).					
8A) Conwy	2,810	1,941	22%	59:32	20:43
8B) Denbighshire	2,818	1,947	22%	58:21	20:45
8C) Caernarfon	2,680	1,811	20%	58:57	20:51
8D) Welshpool	2,611	1,740	19%	59:38	20:35

Both scenario 8A (compared to 4A) and scenario 8B (compared to 4B) show a strong reduction in the count of scene arrivals. The images below show how the count of scene arrivals has changed by locality. The values are the changes from scenario 8A compared to 4A (Conwy, **top left**), from 8B compared to 4B (Denbighshire, **top right**), from 8C compared to 4C (Caernarfon, **bottom left**), and from 8D compared to 4D (Welshpool, **bottom right**), respectively:



For most scenarios, the car-only equivalent shows the largest decrease in arrivals in Powys and Hywel Dda (the middle section of the maps). These areas are the furthest away from the three bases (as shown by the icons on the maps). As helicopters are more likely to travel further than cars, this explains the stronger impact in those regions.

The regions closer to the southern bases (Dafen and Cardiff) see a less strong, but still significant decrease in scene arrivals.

In north Wales, the smallest impact on scene arrivals is in regions close to the merged base. It is much stronger elsewhere in north Wales. For example, merging into Denbighshire has a more negative impact on the southwest, while merging into Caernarfon has a more negative impact on the east. Merging into Welshpool (scenario 8D, bottom right image) has a particularly negative impact on Gwynedd (a region in the northeast).

It is unknown to CSAM Optima what the exact decision process is when it comes to choosing between a car or helicopter. Not all relevant decision criteria may be modelled to the full extent in the current EMRTS model. Especially when the entire model is changed to car-only shifts, the count of responses may be less accurate (too high, too low, or more variable). This is mainly visible in scenarios 8 and 9. The figures above show a strong decrease in the number of responded incidents when crews are only able to respond by car, and therefore, also a strong decrease in workload and utilisation.

3.5 Scenario 9: poor weather (with 3 shifts in Cardiff)

Scenario 9 is identical to scenario 8, except that Cardiff has three daily 12-hour shifts (at 07:00, 14:00 and 19:00 hours) instead of two daily 12-hour shifts (at 14:00 and 19:00 hours). Similar to scenario 8, this scenario also looks at merging the north Wales bases into Conwy (9A), Denbighshire (9B), Caernarfon (9C), or Welshpool (9D). All responses in scenarios 9A, 9B, 9C and 9D are done by car only.

Please note that:

- Scenario 9A, the Conwy variation, is the car-only equivalent of *"Scenario 4 ("car") - 4A) Conwy car + Cardiff car*" from the previous report.
- Scenario 9B, the Denbighshire variation is the car-only equivalent *of "Scenario 4 ("car") - 4B) Denbighshire car + Cardiff car"* in the previous report.
- A non-car equivalent of scenario 9C (merge into Caernarfon) has also been added to the table below (scenario 4C). This is to enable comparisons from scenario 4C to scenario 9C.
- A non-car equivalent of scenario 9D (merge into Welshpool) has also been added to the table below (scenario 4D). This is to enable comparisons from scenario 4D to scenario 9D.
- For convenience, these four "car/helicopter" scenarios are also shown in the results table below to enable direct comparisons to their "car-only" equivalents.

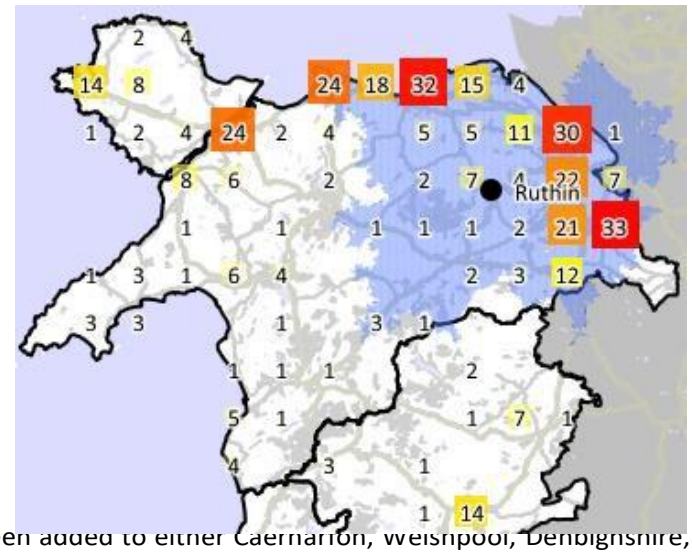
The results of scenarios 8A – 8D and scenarios 9A – 9D are shown in the table **below**:

Scenario	Dispatches	Scene Arrivals	Crew Utilisation	Response Duration (avg)	Veh. Reflex Duration (avg)
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 4 ("car"): 4A and 4B from the previous report. Review the previous report for the full description.					
***4A)** Conwy car + Cardiff car*	*4,099*	*3,217*	*32%*	*54:13*	*25:04*
***4B)** Denbighshire car + Cardiff car*	*4,110*	*3,229*	*32%*	*54:35*	*25:16*
***4C)** Caernarfon car + Cardiff car (new, for comparing with 9C)*	*4,057*	*3,175*	*31%*	*55:53*	*26:03*
***4D)** Welshpool car + Cardiff car (new, for comparing with 9D)*	*4,028*	*3,146*	*31%*	*57:19*	*26:43*
Scenario 8: poor weather (with 2 shifts in Cardiff, at 14:00 and 19:00 hours).					
8A) Conwy	2,810	1,941	22%	59:32	20:43
8B) Denbighshire	2,818	1,947	22%	58:21	20:45
8C) Caernarfon	2,680	1,811	20%	58:57	20:51
8D) Welshpool	2,611	1,740	19%	59:38	20:35
Scenario 9: poor weather (with 3 shifts in Cardiff, at 07:00, 14:00 and 19:00 hours).					
9A) Conwy	2,985	2,113	20%	54:35	20:13
9B) Denbighshire	2,987	2,115	20%	53:38	20:18
9C) Caernarfon	2,844	1,972	18%	53:30	20:16
9D) Welshpool	2,773	1,902	17%	53:27	20:05

These results show that the variations of scenario 9 also have a much lower count of scene arrivals than their scenario 4 counterparts. However, there are typically 170 extra scene arrivals compared to their scenario 8 counterparts. Furthermore, the extra car-only shift in Cardiff causes the overall utilisation in scenario 9 to be about 2% lower than in scenario 8. However, this improved availability does improve average response durations and vehicle reflex durations in scenario 9, compared to scenario 8.

3.6 Scenario 10: add an additional car on top of scenario 1

In Scenario 10, the current base arrangement (Scenario 1) is used, but an extra daily 12-hour car shift has been added on top.



The image on the **right** shows the count of incidents in a 10x10 mile grid that have not received a simulated response in Scenario 1 (= the "new unmet need" of Scenario 1). This shows that most of the simulated unmet need in Scenario 1 remains near Wrexham and Denbighshire, not in North Powys. One possible location that could cover both Wrexham and Denbighshire within a 40-minute drive time (indicated by the blue area) is Ruthin.

In Scenario 10, the extra daily 12-hour car shift has been added to either Caernarfon, Welshpool, Denbighshire, or Ruthin. The simulated number of scene arrivals (**top table**) and average response duration (**bottom table**) are shown below:

Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
10A) Caernarfon	2,917	2,935	2,953	2,963	2,973	2,978	2,997
10B) Welshpool	2,918	2,935	2,934	2,947	2,957	2,970	2,976
10C) Denbighshire	2,930	2,959	2,981	3,002	3,016	3,033	3,044 (#)
10D) Ruthin	2,924	2,948	2,976	3,002	3,010	3,019	3,025

Response Duration (Average)	A daily, 12-hour car-only shift was added to Cardiff at:						
	08:00	09:00	10:00	11:00	12:00	13:00	14:00
10A) Caernarfon	57:07	56:14	55:53	55:29	55:21	55:00	55:02
10B) Welshpool	56:55	56:48	56:22	56:56	56:24	56:15	55:54
10C) Denbighshire	55:59	55:55	54:53	54:28	54:01	53:47	53:26 (#)
10D) Ruthin	55:43	55:53	55:43	55:01	54:44	54:25	53:40

In general, the best time to add a car shift is at 14:00 – 02:00 hours (marked as green in the tables). This leads to the highest count of scene arrivals and fastest average response durations. The best-performing scenario variation is scenario 10C in which a car shift has been added to Denbighshire at 14:00 – 02:00 hours. This scenario has been marked with (#) above.

Scenario 10D (Ruthin) performs well, but not better than Scenario 10C (Denbighshire). The extra car in Ruthin has good demand coverage within a 40-minute drive time, as it is halfway between Wrexham and Denbighshire. However, it is not near any demand hotspot, which means it almost always has to drive a long way. This is different to scenario 10C (Denbighshire), where the added car is near demand hotspots.

3.7 Summary of scenarios 1 - 10

The table **below** shows the results of scenarios 1 - 10 as covered in this and the previous reports:

Scenario	Dispatches	Scene Arrivals	Crew	Response	Veh. Reflex
Adjusted Baseline	3,620	2,743	39%	1:05:35	27:36
Scenario 1: first, add one daily 07:00 - 19:00 crew (can use car or helicopter) to Cardiff Heliport:					
1) Add shift to Cardiff	3,787	2,906	34%	58:09	25:44
Scenario 2: then merge the two crews of Welshpool and Caernarfon into one crew at:					
2A) Caernarfon	3,681	2,802	41%	1:04:00	27:36
2B) Welshpool	3,674	2,794	40%	1:03:36	27:47
2C) Conwy	3,677	2,797	40%	1:02:34	27:07
2D) Denbighshire	3,671	2,791	40%	1:02:20	27:21
Scenario 3 (car): then add a second 14h - 02h crew shift (car-only) to the merged base of scenario 2:					
3A car) Caernarfon	3,781	2,903	34%	1:00:07	26:35
3B car) Welshpool	3,737	2,857	34%	1:01:33	27:06
3C car) Conwy	3,834	2,954	34%	58:39	25:25
3D car) Denbighshire	3,840	2,960	34%	58:41	25:27
Scenario 3 (air): or allow the second 14h - 02h crew to also respond with a second helicopter:					
3A air) Caernarfon	3,964	3,083	36%	57:17	26:11
3B air) Welshpool	3,972	3,090	36%	57:27	26:27
3C air) Conwy	3,954	3,073	36%	57:14	25:38
3D air) Denbighshire	3,955	3,074	36%	56:40	25:50
Scenario 4 ("change"): continuing on scenario 3C/3D (car), change start time of Cardiff day shift to 14h:					
4A) Conwy car + change Cardiff	4,027	3,147	37%	58:53	26:24
4B) Denbighshire car + change Cardiff	4,034	3,153	37%	58:33	26:30
4C) Caernarfon car +change Cardiff	3,985	3,104	37%	59:45	27:20
4D) Welshpool car +change Cardiff	3,954	3,073	36%	1:02:07	28:06
Scenario 4 ("car"): continuing on scenario 3C/3D (car), add a 14h - 02 crew shift (car-only) to Cardiff:					
4A) Conwy car + Cardiff car	4,099	3,217	32%	54:13	25:04
4B) Denbighshire car + Cardiff car	4,110	3,229	32%	54:35	25:16
4C) Caernarfon car + Cardiff car	4,057	3,175	31%	55:53	26:03
4D) Welshpool car + Cardiff car	4,028	3,146	31%	57:19	26:43
Scenario 5: similar to scenario 4B ("car"), but the 14:00 shift at Denbighshire is car/helicopter, instead of car-only.					
5) Denbighshire air + Cardiff car	4,203	3,320	33%	53:16	25:29
Scenario 6: a hybrid of 4B ("car") and 5. The Denbighshire 14:00 shift is car-only, except from April until September:					
6) Denbighshire air (6mo) + Cardiff car	4,174	3,293	32%	54:07	25:22
Scenario 7: helicopters can fly during daylight only. These are variations of scenarios 4B, 5 and 6 above.					
7-4Bv1) Not applied to H67	4,079	3,198	31%	55:07	25:13
7-4Bv2) Applied to all shifts	3,937	3,056	30%	52:06	23:15
7-5v1) Not applied to H67	4,136	3,254	32%	53:34	25:04
7-5v2) Applied to all shifts	3,987	3,107	30%	51:21	23:17
7-6v1) Not applied to H67	4,127	3,247	31%	53:57	25:00
7-6v2) Applied to all shifts	3,985	3,105	30%	51:32	23:18
Scenario 8: poor weather (with 2 shifts in Cardiff, at 14:00 and 19:00 hours).					
8A) Conwy	2,810	1,941	22%	59:32	20:43
8B) Denbighshire	2,818	1,947	22%	58:21	20:45
8C) Caernarfon	2,680	1,811	20%	58:57	20:51
8D) Welshpool	2,611	1,740	19%	59:38	20:35
Scenario 9: poor weather (with 3 shifts in Cardiff, at 07:00, 14:00 and 19:00 hours).					
9A) Conwy	2,985	2,113	20%	54:35	20:13
9B) Denbighshire	2,987	2,115	20%	53:38	20:18
9C) Caernarfon	2,844	1,972	18%	53:30	20:16
9D) Welshpool	2,773	1,902	17%	53:27	20:05
Scenario 10: based on Scenario 1, add a 12-hour car-only shift at 14h – 02h at:					
10A) Caernarfon	3,878	2,997	29%	55:02	24:57
10B) Welshpool	3,857	2,976	29%	55:54	25:13
10C) Denbighshire	3,925	3,044	29%	53:26	24:05
10D) Ruthin	3,905	3,025	29%	53:40	24:21

4 CONCLUSIONS & RECOMMENDATIONS

4.1 Conclusions

For conclusions around scenarios 1 - 4, please see the original report: *'EMRTS Unmet Need Scenarios 01 - 04.pdf', 28 May 2022, Tef Jansma*.

Scenario 5 is an adjusted version of scenario 4B ("car"): in scenario 5, the 14:00 shift at Denbighshire is a car/helicopter shift, instead of car-only. This leads to an increase of about 100 extra scene arrivals. It does not lead to a significant change in average response durations or average vehicle reflex durations.

Scenario 6 has shown that, if the helicopter in Denbighshire for the 14:00 shift would only be available 6 months of the year, the best timing is from April to September. The other 6 months of the year the Denbighshire 14:00 shift operates as a car-only shift. The number of scene arrivals and response durations of scenario 6 is in between those of scenarios 4B and 5. The April-September variation shows the highest count of scene arrivals. The overall average response durations seem less dependent on the timing.

Scenario 7 takes it another step further, by restricting the flying times of some, or all of the helicopters in scenarios 4B, 5 and 6 by daylight hours. In all variations of scenario 7, there is a reduction in scene arrivals. The strongest impact is seen in the middle of Wales (Powys, Hywel Dda), as the cars are much less likely to drive long distances from Cardiff, Dafen or Denbighshire. Time-wise, the strongest decrease in scene arrivals occurs in the late evenings and nights. This is also when the response durations improve the most, as longer trips through helicopters are "avoided" by not flying outside daylight hours.

Scenario 8 contains variations of scenario 4 ("change"), with all shifts being car-only, to simulate permanent poor weather. This shows a strong reduction in the number of scene arrivals and utilisation. The average response durations and average vehicle reflex durations are less affected.

Scenario 9 contains variations of scenario 4 ("car"), with all shifts being car-only, to simulate permanent poor weather. The impacts are very similar to scenario 8: reduced scene arrivals and utilisation, but little impact on response durations. Due to scenario 9 having three shifts in Cardiff (at 07:00, 14:00 and 19:00) instead of two in scenario 8 (at 14:00 and 19:00), scenario 9 does typically have 170 more scene arrivals per year than scenario 8.

Scenario 10 uses the configuration of Scenario 1, but with an extra 12h car-only shift. The best placement out of Caernarfon, Welshpool, Denbighshire, and Ruthin is an extra 14h-02h car shift in Denbighshire.

4.2 Recommendations

All figures, especially the number of scene arrivals, are highly dependent on the "incident abandonment logic". Hence, CSAM Optima strongly recommends interpreting figures as relative differences (e.g. a 200 increase per year instead of 2,800 and 3,000).

This report covers the final version of Scenarios 1-10. Follow-up work will be treated as separate work.

5 SENSITIVITY MODELLING

5.1 Recap: scenario 3 (car)

From "*EMRTS Unmet Need Scenarios 01 – 04*", version 2.0, 28 May 2022:

***Scenario 3 (car) builds on top of scenario 2**, as follows:*

- *In scenario 1, a daily 07:00 - 19:00 crew shift (car / air) was added to Cardiff.*
- *Then, in scenario 2A - 2D, the crews in Caernarfon and Welshpool have been merged as 1 crew.*
- *Now, in scenario 3A - 3D, a second crew shift has been added to the merged base of scenario 2A - 2D. In this scenario, it is assumed that the second crew shift can only use a second car, not a second helicopter. In each scenario, the second shift is a daily 12-hour shift. Seven variations have been tested, by only adjusting the start time of the second crew as 08:00, 09:00, 10:00, 11:00, 12:00, 13:00 or 14:00 hours.*

***Scene Arrivals** (Count)*	***A daily, 12-hour car-only shift was added to the merged base at:***						
	08:00	***09:00***	***10:00***	***11:00***	***12:00***	***13:00***	***14:00***
***3A car)** Caernarfon*	*2,829*	*2,843*	*2,867*	*2,866*	*2,889*	*2,891*	*2,903*
***3B car)** Welshpool*	*2,811*	*2,821*	*2,830*	*2,835*	*2,849*	*2,856*	*2,857*
***3C car)** Conwy*	*2,844*	*2,874*	*2,893*	*2,912*	*2,929*	*2,949*	*2,954*
***3D car)** Denbighshire*	*2,843*	*2,872*	*2,905*	*2,912*	*2,931*	*2,947*	***2,960***

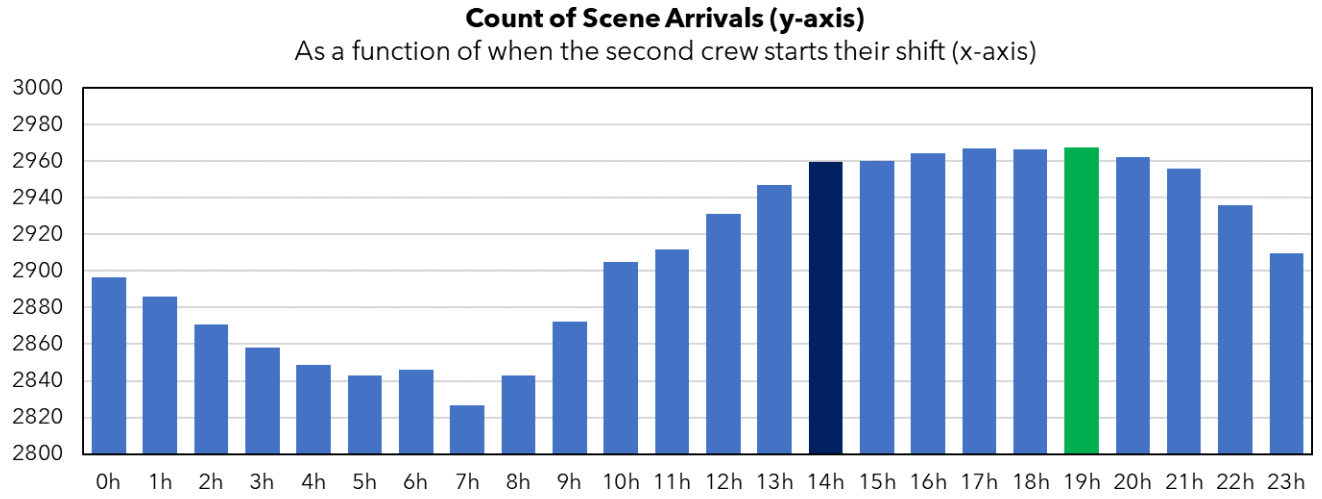
As highlighted in green above, the best performing scenario was scenario 3D (car), with the second crew working from 14:00 – 02:00 hours. One suggestion from EMRTS / partners was that this could possibly be improved upon further. This could be done by considering any shift start between 00:00 to 23:00 hours. For example, how would a scenario perform if the second shift works from 20:00 – 08:00 hours? In this Sensitivity Modelling section, Scenario 3 (car) has been extended to consider any hourly start time for the second crew.

5.2 Scenario 3 (car): extended results

Only the best-performing variation, which is Scenario 3D (car) Denbighshire, has been extended. The results are shown **below**:

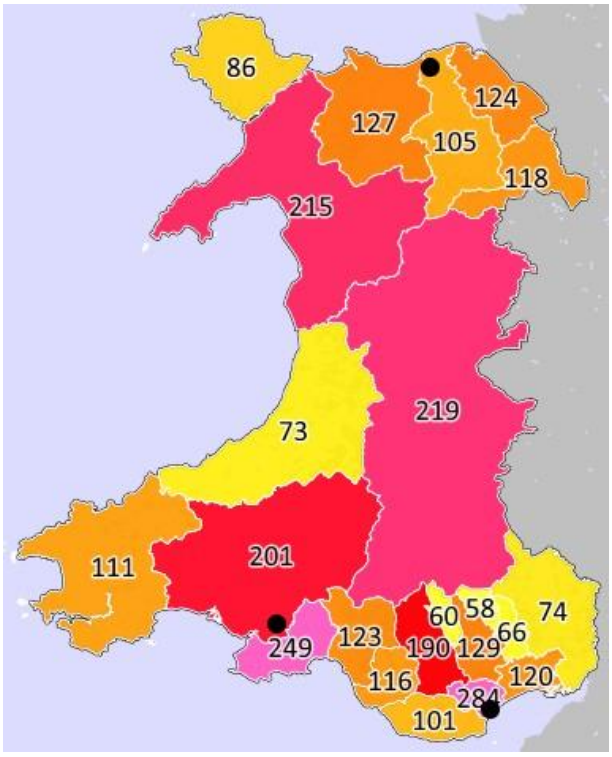
Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to the merged Denbighshire base at:																							
	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
3D car) Denbighshire	2,897	2,886	2,871	2,858	2,849	2,843	2,846	2,826	2,843	2,872	2,905	2,912	2,931	2,947	2,960	2,960	2,964	2,967	2,967	2,968	2,962	2,956	2,936	2,910

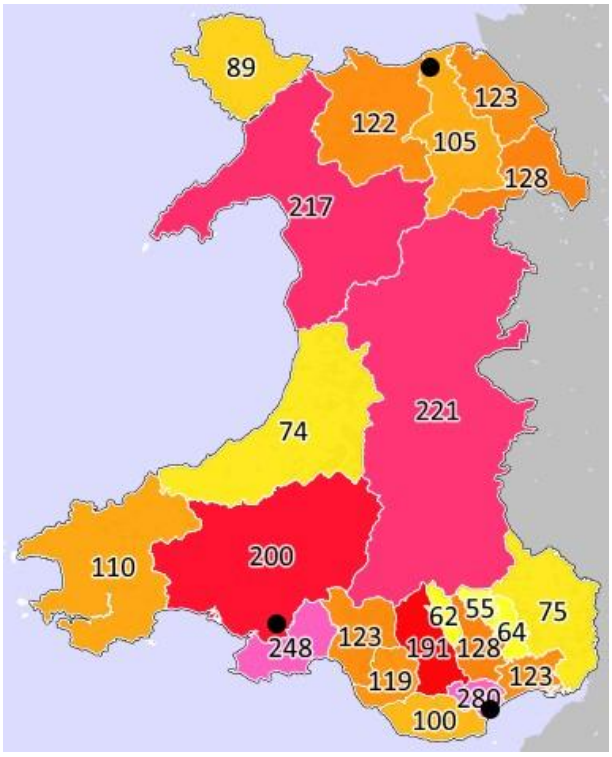
In visual form, the table above looks as below. The original best performing scenario is marked as **dark blue**. Please note that the y-axis is compressed. The difference between lowest bar (2,826) and highest bar (2,968) is only small:



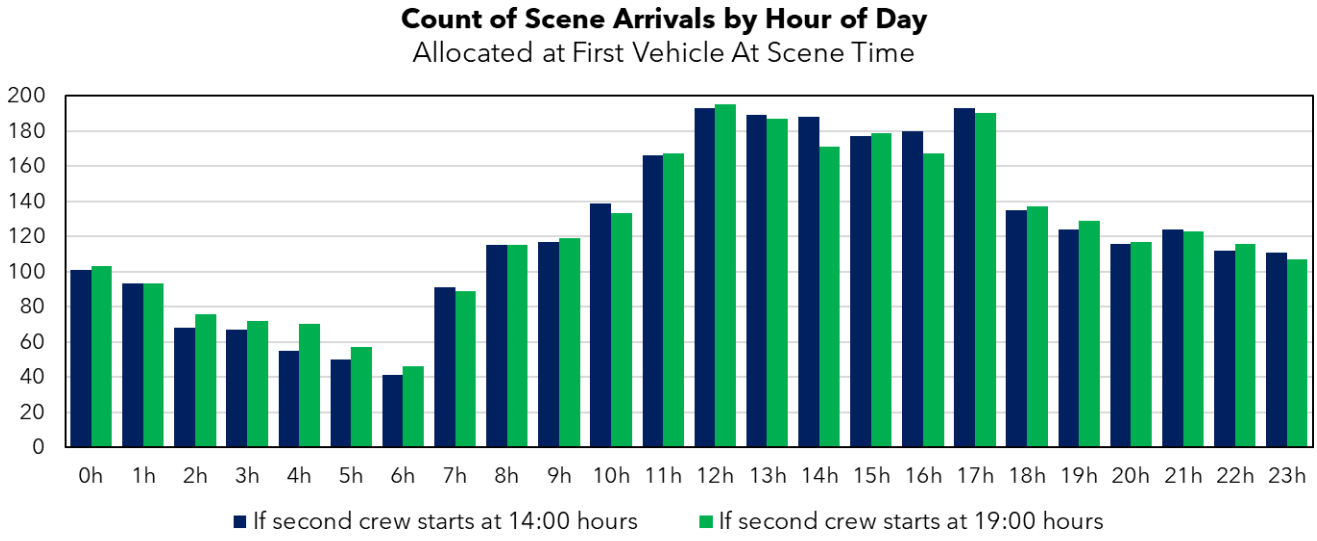
These results suggest that the count of scene arrivals can indeed be improved upon by having the second crew in Denbighshire start later. For example, from 19:00 – 07:00 hours (marked as **green**). However the additional benefits in terms of count of Scene Arrivals are very small: from 2,960 (start at 14:00) to 2,968 (start at 19:00), an increase of only 8 extra arrivals on a yearly basis.

The images below show the count of Scene Arrivals by locality. **Left** shows this for the 14:00 start time variation, **right** shows this for the 19:00 start time variation. This shows that there is no significant difference geographically between the two variations:





As shown **below**, the count of scene arrivals by hour of day (allocated at first vehicle at scene time) shows little difference between the two variations. If the second crew works from 19:00 – 07:00 hours, then there are slightly more scene arrivals between 02:00 – 07:00 hours, but also slightly fewer scene arrivals between 14:00 – 19:00 hours:



OVERVIEW OF PROVIDED FILES

The table **below** shows all the main outputs that have been delivered as part of the "Unmet Need Scenarios" modelling:

Filename	Date provided	Provided by	Provided to
EMRTS Unmet Need Scenarios.pdf	14 April 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 01 - 04.pdf *[is V2]*	30 May 2022 28 July 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 09.pdf *[is V2]*	30 May 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 09 (V3).pdf	29 June 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 10 (V4).pdf	28 July 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 10 (V4) - Notes.docx	28 July 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 10 (V4) - Arrivals Split By Base (Scenario 5+6 Only).xlsx	28 July 2022	Tef Jansma	David Rawlinson Mark Winter
EMRTS Unmet Need Scenarios 05 - 10 (V4) - Arrivals Split by Vehicle Type (All Main Scenarios).xlsx	28 July 2022	Tef Jansma	David Rawlinson Mark Winter

11 Appendix J Internal Working Group summary

Following initial presentation of the strategic review findings to EMRTS staff, a working group was convened consisting of representation from senior management, Consultant and CCP representatives from across Wales. The WAACT were also represented, and the outcome of meetings fed back to the trustees.

Meetings were conducted in July and August 2022, and materials circulated before each meeting included additional sensitivity analysis, and further drill down of clinical data.

From meetings, there were 4 clear themes emerging:

People, Patients, Aviation, Charity

Underpinning these themes sat Clinical/ Economic Data

As the focus of the service development proposal is around patients, the relevant data is included below. People, aviation and Charity are subject to separate workstreams as outlined earlier.

A table of figures is included below;

11.1 Data analysis

11.1.1 Terminology

Unmet Need – existing unmet need in current service spec, forming part of the total demand figure.

“New Unmet Need”- there is a concern that whilst a there is a net gain of unmet need being serviced, there may be new unintended unmet need within existing service areas. Therefore, we have attempted to quantify this new unmet need by locality, as well as patient groups.

11.2 Unmet Need

The unmet need data is derived from the ECCH, through cotemporaneous recording of “call plus” codes against any live incidents in the WAST CAD that would ordinarily have triggered a further review and potential tasking. This process was introduced in 2019 to enhance the existing ad-hoc recording of unmet need through an e-form. The introduction of a 24-hour ECCH with full complement of staff further enhanced the reliability of data collection and gave us almost real time data on demand as well as capacity, in a combined internal dataset. This data set gives us detailed context of the unmet need, including whether a resource was already committed at the time, or whether it was simply inaccessible due to other reasons such as the distance required to respond (e.g. by road) introducing an unacceptable delay to patient care. Through regular review, and using the data to inform and evaluate service developments we are confident that this is the best we can do to monitor the area short of individually reviewing 500k+ calls per year for a second time. In addition we do sense check volume of the overall demand with external datasets, and historical planning work that has been built on since 2012.

A brief summary of the unmet need follows in aggregate form, detailing the reason recorded for the unmet need, regional breakdowns, including nature of the incidents. Please note the numbers presented here may be lower than previously published counts, due to the data flows and live nature of the datasets used. Thus these are illustrative only to give insight into the granularity of data available.

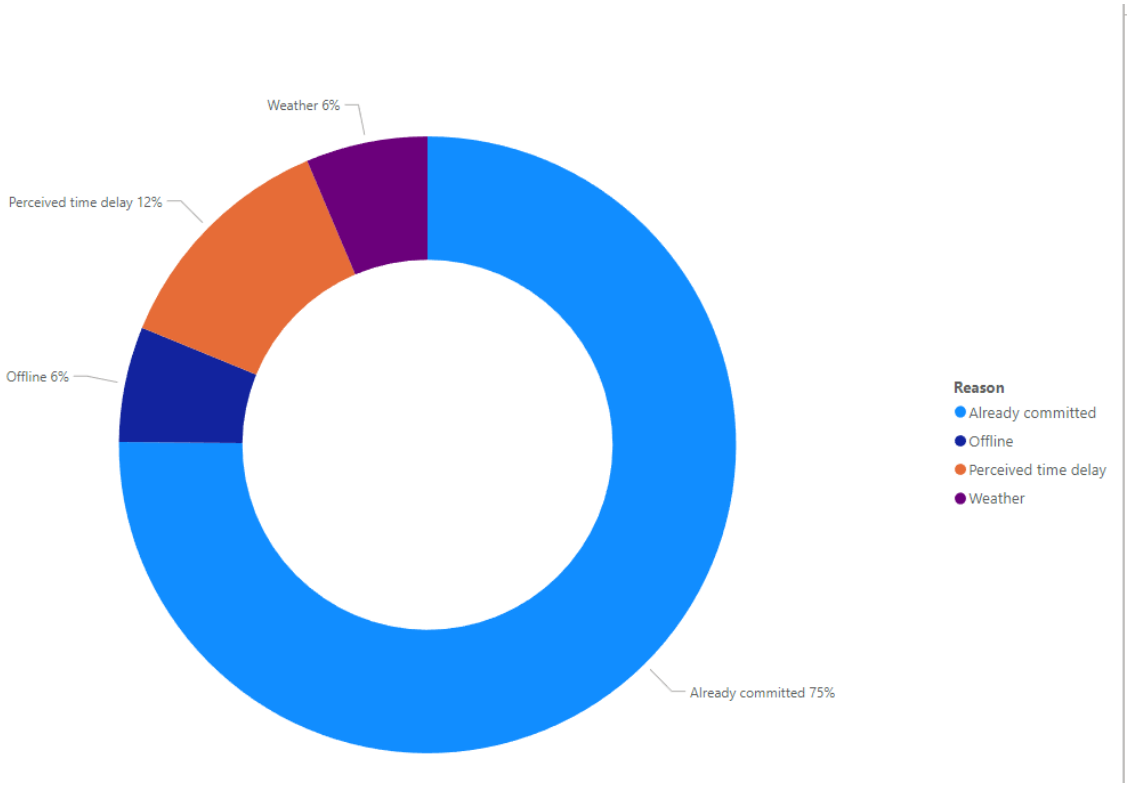


Figure 4 Unmet need categories

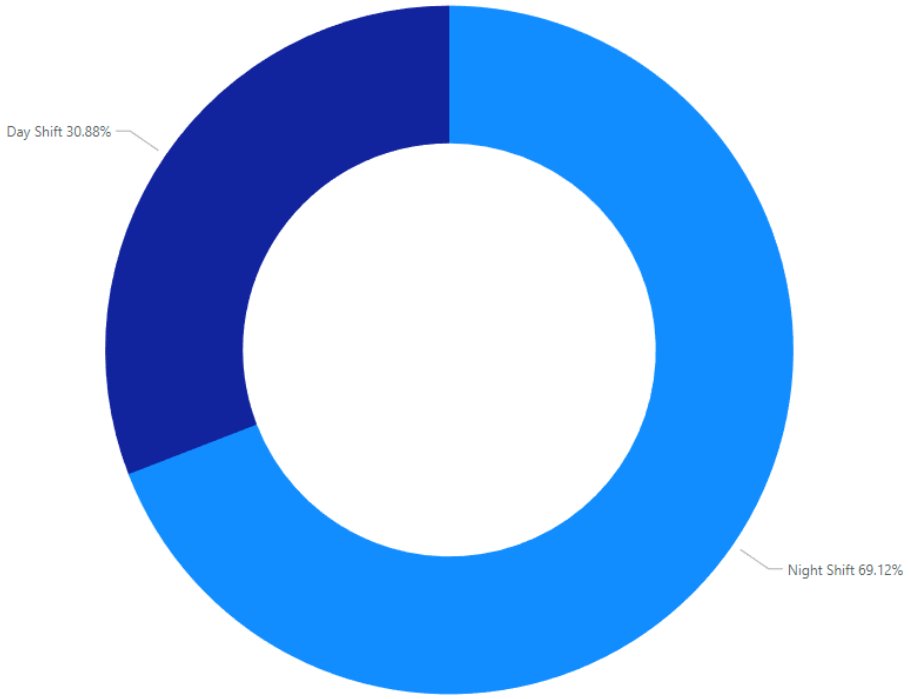


Figure 5 Unmet Need by shift (19:00 - 06:59 = Night)

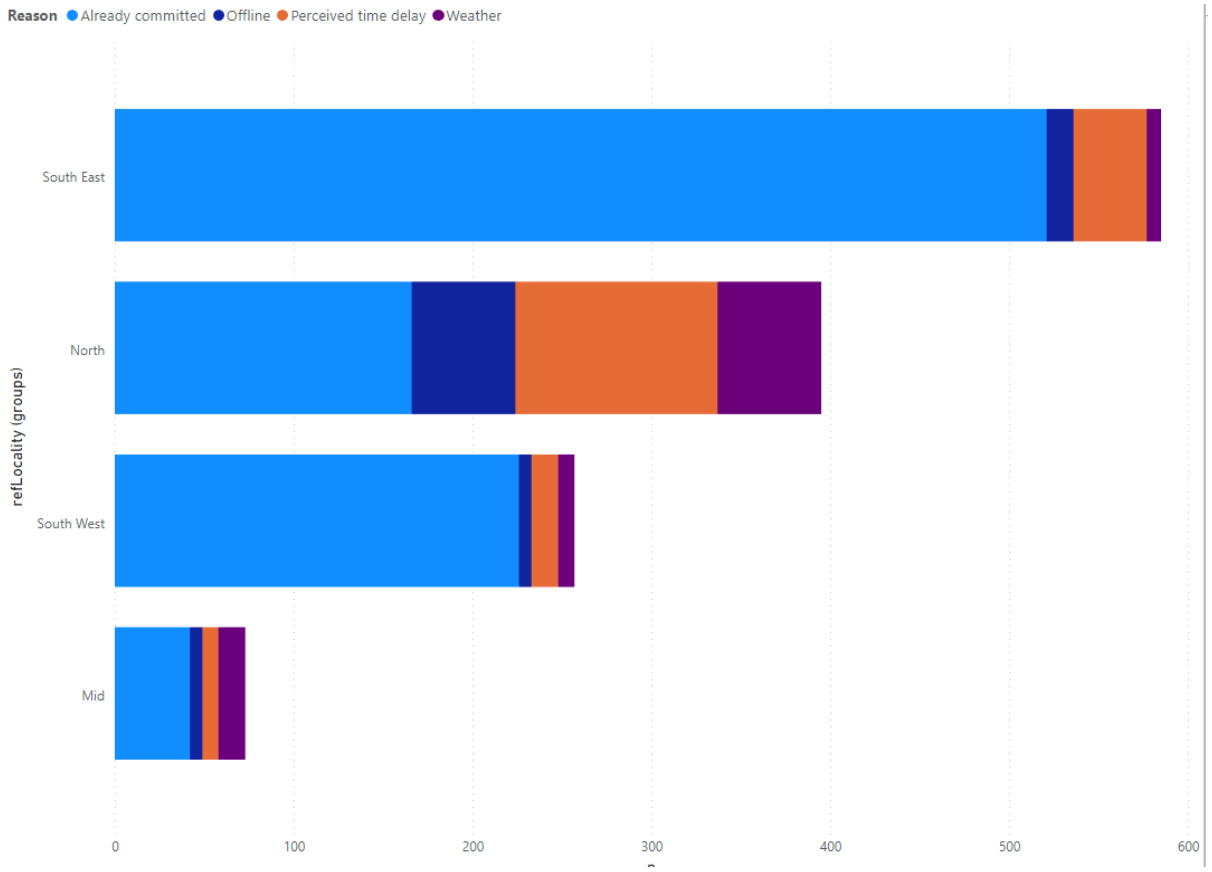


Figure 6 Unmet need by locality group and reason

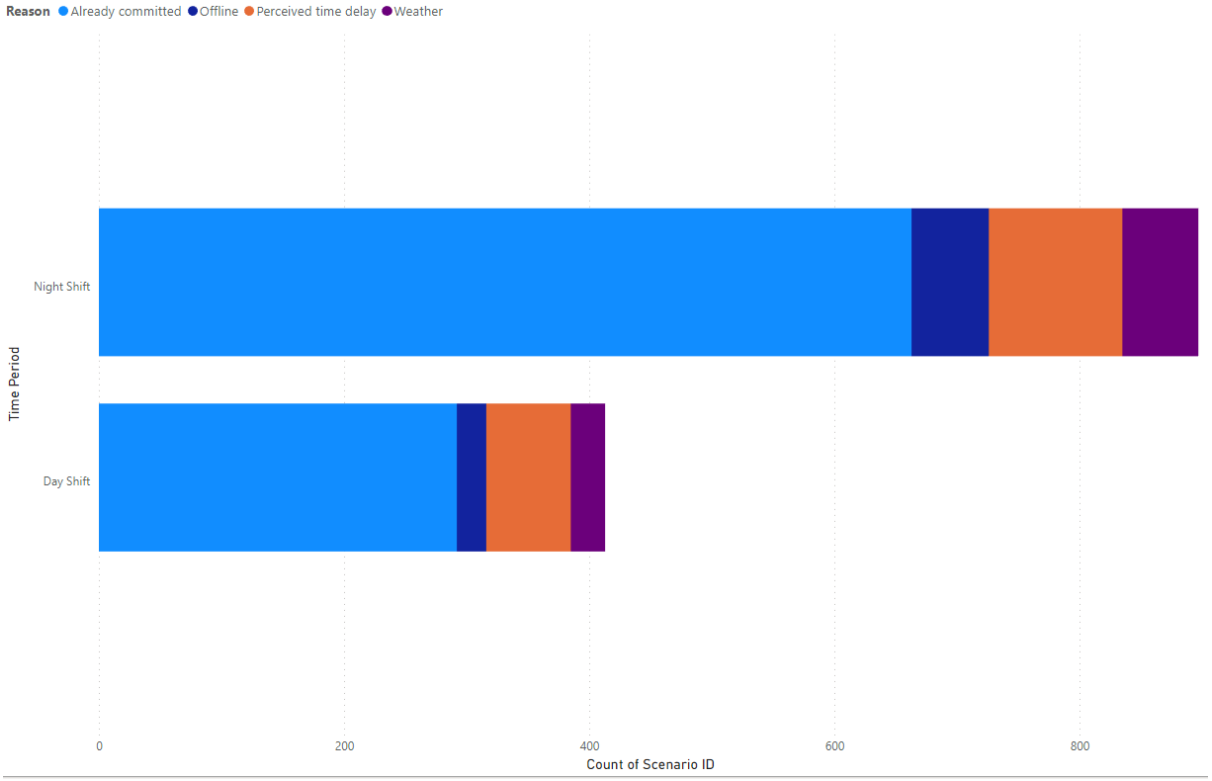


Figure 7 Unmet need by time period and reason

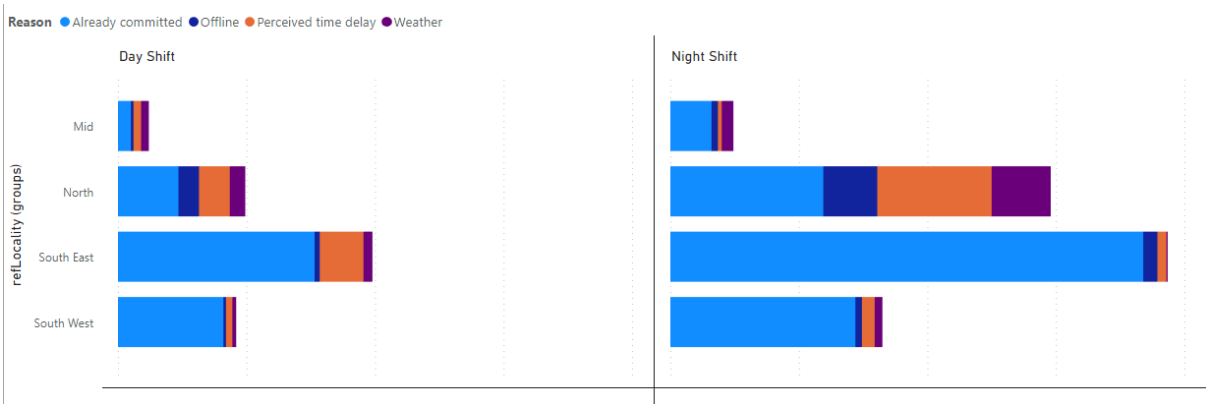


Figure 8 Unmet need by tie period and locality group

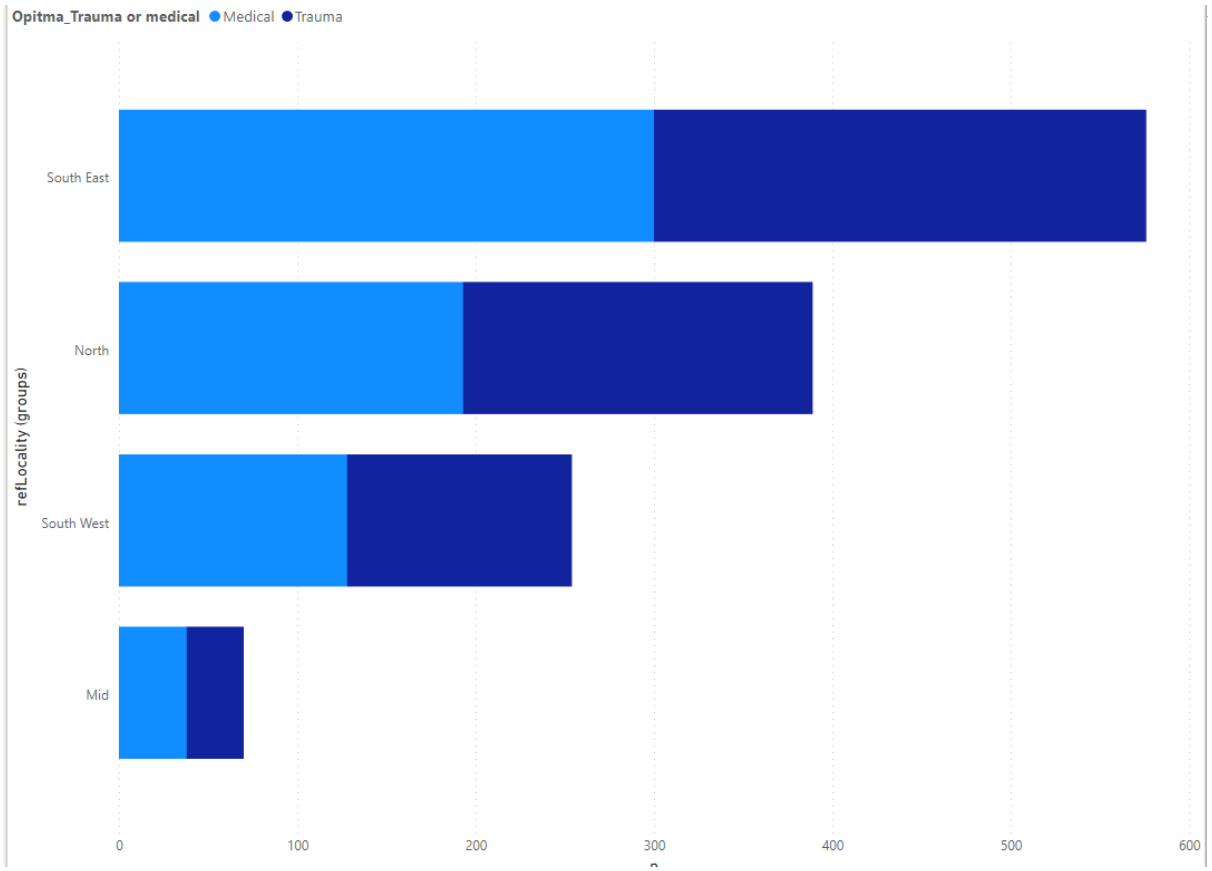


Figure 9 Unmet need by locality group and nature

refLocality (groups)	Medical	Trauma	**Total**
⊞ South East	300	276	**576**
⊞ North	193	196	**389**
⊞ South West	128	126	**254**
⊞ Mid	38	32	**70**
Total	**659**	**630**	**1289**

Figure 10 Unmet need by locality group and nature

Time Period	Day Shift			Night Shift			Total
refLocality (groups)	Medical	Trauma	**Total**	Medical	Trauma	**Total**	
South East	107	85	**192**	193	191	**384**	**576**
North	54	42	**96**	139	154	**293**	**389**
South West	52	37	**89**	76	89	**165**	**254**
Mid	10	11	**21**	28	21	**49**	**70**
Total	**223**	**175**	**398**	**436**	**455**	**891**	**1289**

Figure 11 Unmet need by locality group, time period and nature

Locality	Medical	Trauma	Total
Cardiff	66	90	**156**
Swansea	66	62	**128**
Newport	44	38	**82**
Gwynedd	39	39	**78**
Caerphilly	42	35	**77**
Carmarthenshire	37	39	**76**
Flintshire	33	37	**70**
Powys	38	32	**70**
Neath Port Talbot	39	26	**65**
Wrexham	31	32	**63**
Conwy	30	32	**62**
Bridgend	31	23	**54**
Denbighshire	28	25	**53**
Pembrokeshire	25	25	**50**
Monmouthshire	18	22	**40**
Torfaen	22	16	**38**
Blaenau Gwent	20	14	**34**
Isle of Anglesey	17	16	**33**
Ceredigion	15	15	**30**
Merthyr Tydfil	18	12	**30**
Total	**659**	**630**	**1289**

Figure 12 Unmet need by locality and nature

Time Period / Locality	Day Shift Medical	Day Shift Trauma	Day Shift **Total**	Night Shift Medical	Night Shift Trauma	Night Shift **Total**	**Total**
Cardiff	26	33	**59**	40	57	**97**	**156**
Swansea	24	23	**47**	42	39	**81**	**128**
Newport	13	10	**23**	31	28	**59**	**82**
Gwynedd	12	8	**20**	27	31	**58**	**78**
Caerphilly	12	10	**22**	30	25	**55**	**77**
Carmarthenshire	17	5	**22**	20	34	**54**	**76**
Flintshire	10	10	**20**	23	27	**50**	**70**
Powys	10	11	**21**	28	21	**49**	**70**
Neath Port Talbot	18	6	**24**	21	20	**41**	**65**
Wrexham	6	9	**15**	25	23	**48**	**63**
Conwy	9	5	**14**	21	27	**48**	**62**
Bridgend	8	8	**16**	23	15	**38**	**54**
Denbighshire	9	4	**13**	19	21	**40**	**53**
Pembrokeshire	11	9	**20**	14	16	**30**	**50**
Monmouthshire	4	10	**14**	14	12	**26**	**40**
Torfaen	8	3	**11**	14	13	**27**	**38**
Blaenau Gwent	8	1	**9**	12	13	**25**	**34**
Isle of Anglesey	6	2	**8**	11	14	**25**	**33**
Ceredigion	2	4	**6**	13	11	**24**	**30**
Merthyr Tydfil	10	4	**14**	8	8	**16**	**30**
Total	**223**	**175**	**398**	**436**	**455**	**891**	**1289**

Figure 13 Unmet need by locality and nature (trauma vs medical)

OPTIMA_Nature	Mid	North	South East	South West	**Total**
Cardiac Arrest	18	77	100	54	**249**
Other Trauma	11	73	115	41	**240**
Falls	11	59	79	46	**195**
Unconscious	5	40	65	18	**128**
Road Incidents	6	37	42	25	**110**
Breathing Problems	2	23	41	12	**78**
Seizures	5	19	37	15	**76**
Other Medical		21	35	15	**71**
Penetrating Trauma		21	31	8	**60**
Cardiac related	7	3	6	3	**19**
Burns or Explosions	1	5	7	4	**17**
Transfer		1	12	3	**16**
Pregnancy or Childbirth Related	1	8	2	3	**14**
Stroke		1	2	5	**8**
Drowning	2	1	1	1	**5**
Animal related injuries	1		1	1	**3**
Total	**70**	**389**	**576**	**254**	**1289**

Figure 14 Unmet need by nature and locality

11.3 Job Cycles

Data on job cycles by area was requested and is tabulated below, for a 36-month period, and by nature. The job cycle is factored into the model that has been run, as well as utilisation data to add context to the quantity of calls.

Trauma or Medical	Medical		Trauma		**Total**	
Locality	Mean	Median	Mean	Median	**Mean**	**Median**
Blaenau Gwent	203	204	204	188	**203**	**189**
Pembrokeshire	192	178	204	164	**199**	**169**
Neath Port Talbot	177	164	187	171	**182**	**168**
Ceredigion	207	170	171	154	**181**	**158**
Rhondda Cynon Taff	172	157	184	168	**179**	**165**
Denbighshire	180	156	178	148	**179**	**150**
Bridgend	188	187	167	157	**175**	**166**
Wrexham	199	175	153	137	**169**	**149**
Torfaen	173	174	164	157	**168**	**164**
Flintshire	174	161	165	145	**168**	**155**
Monmouthshire	185	179	161	145	**168**	**151**
Caerphilly	176	161	158	147	**167**	**151**
Merthyr Tydfil	159	143	170	151	**166**	**151**
Conwy	153	133	174	156	**166**	**153**
Powys	163	135	155	133	**158**	**134**
Carmarthenshire	150	139	163	146	**158**	**142**
Isle Of Anglesey	148	130	161	142	**155**	**140**
Swansea	158	133	153	132	**155**	**133**
Vale Of Glamorgan	153	135	156	131	**154**	**134**
Newport	152	136	152	134	**152**	**135**
Gwynedd	143	120	152	138	**149**	**129**
Out of Area	171	173	138	117	**147**	**121**
Cardiff	131	120	114	94	**123**	**104**
Total	**161**	**145**	**160**	**143**	**161**	**143**

Figure 15 Primary mission job cycles in minutes by locality, and nature

11.4 Additional modelling work- August 22

Based on feedback from the roadshow and working group, a number of additional modelling scenarios were commissioned from within the available resource to answer queries. This takes the number of modelled scenarios to over 200, with 41 best performing or comparator scenarios reviewed in detail. In addition to enable further drill down into the detail of the incidents attended in the models, extracts of raw data have been provided to the service for linkage to other datasets including historical EMRTS responses and ambulance incident data. The latter analysis is not routine with NHS Wales and has not been done before to our knowledge but is vital for transparency and to answer the new questions posed by EMRTS staff.

11.5 Overview of extracted data

The extracted incident ID data matched to 4082 incidents in the WAST data. A summary of the extract, and best performing scenario are illustrated below by regions. Please note due to the nature of the simulations and running up to 10 random seeds, this is a snapshot, and absolute figures cannot be compared to others presented in the report. The relative change however is valid.

acc AmbulanceCADIncident.StatsCurrentCensusLocalAuthorityName	Demand	1	2A	3D car	3B air	4B change	4B car	5	6	7-5v1	8B	9B	10C
Cardiff	425	281	284	284	295	301	324	320	317	323	267	329	279
Swansea	334	232	236	237	235	248	249	262	258	250	237	247	240
Rhondda Cynon Taf	294	195	189	199	200	219	212	225	219	221	152	163	196
Carmarthenshire	269	199	189	197	213	206	207	216	205	206	143	144	203
Gwynedd	268	224	202	214	237	216	215	238	233	228	34	39	237
Powys	250	197	192	194	210	212	204	212	213	208	9	5	205
Caerphilly	202	131	121	126	121	138	147	143	148	146	96	118	120
Newport	195	108	116	112	121	127	139	138	147	142	113	142	110
Neath Port Talbot	186	113	109	110	118	122	124	135	128	130	116	122	115
Bridgend	172	115	109	111	108	118	127	119	125	127	81	92	107
Conwy	155	106	94	118	123	118	118	122	121	121	100	105	125
Wrexham	154	106	100	104	113	107	110	115	107	112	42	41	116
Flintshire	147	88	74	109	110	109	106	108	104	109	81	90	112
Pembrokeshire	145	112	113	114	127	121	114	122	125	110	1		112
The Vale of Glamorgan	139	110	113	112	115	114	124	122	124	122	86	119	114
Denbighshire	129	87	74	100	98	98	100	102	99	101	68	73	102
Monmouthshire	114	82	80	83	76	86	87	90	90	88	50	40	79
Isle of Anglesey	111	83	77	79	85	81	79	85	84	83	9	10	86
Ceredigion	109	82	78	74	89	82	75	89	83	75			78
Blaenau Gwent	102	57	52	55	50	62	62	64	69	62	39	41	59
Torfaen	98	72	73	74	72	73	79	79	77	78	48	48	72
Merthyr Tydfil	84	62	60	61	66	67	74	73	71	74	47	45	61
Total	**4082**	**2842**	**2735**	**2867**	**2982**	**3025**	**3076**	**3179**	**3147**	**3116**	**1819**	**2013**	**2928**

Figure 16 Extracted data summary (Optima) by locality and scenario

Opitma_Trauma or medical	Demand	1	2A	3D car	3B air	4B change	4B car	5	6	7-5v1	8B	9B	10C
Trauma	2192	1550	1491	1560	1637	1649	1681	1743	1724	1705	965	1065	1596
Medical	1890	1292	1244	1307	1345	1376	1395	1436	1423	1411	854	948	1332
Total	**4082**	**2842**	**2735**	**2867**	**2982**	**3025**	**3076**	**3179**	**3147**	**3116**	**1819**	**2013**	**2928**

Figure 17Extracted data summary by nature and scenario

OPTIMA_Nature	Demand	1	2A	3D car	3B air	4B change	4B car	5	6	7-5v1	8B	9B	10C
Other Trauma	819	564	548	566	602	604	621	644	642	630	357	384	585
Cardiac Arrest	701	532	505	520	536	538	559	565	564	560	323	368	544
Falls	574	399	375	396	419	420	423	443	436	430	251	292	399
Road Incidents	503	381	369	386	403	405	414	428	421	412	231	248	397
Unconscious	374	235	229	252	254	264	269	276	269	271	182	189	248
Seizures	217	148	139	150	149	156	157	166	160	158	97	106	149
Breathing Problems	207	120	118	122	130	137	127	138	137	131	85	94	127
Penetrating Trauma	189	113	108	115	118	125	126	133	125	133	88	92	120
Other Medical	171	112	102	112	115	120	122	123	126	124	86	90	112
Transfer	95	73	76	76	80	80	79	85	85	83	42	55	74
Cardiac related	64	45	45	44	48	46	47	48	48	47	18	25	48
Burns or Explosions	56	38	39	42	39	40	42	40	41	41	22	33	42
Drowning	37	44	42	44	44	44	46	44	46	47	13	12	42
Pregnancy or Childbirth Related	36	11	13	15	16	17	17	18	15	19	9	9	15
Stroke	25	16	17	16	17	18	18	17	19	18	12	12	15
Animal related injuries	14	11	10	11	12	11	9	11	13	12	3	4	11
Total	**4082**	**2842**	**2735**	**2867**	**2982**	**3025**	**3076**	**3179**	**3147**	**3116**	**1819**	**2013**	**2928**

Figure 18 Extracted data summary by nature and scenario

11.6 Welshpool options

As a result of early feedback Welshpool was added back in to test the impact against various scenarios. Welshpool has now been included in both the full suite of results, but also in the additional twilight scenario proposed by staff.

The results reveal that whilst there is a marginal gain of 16 scene arrivals per year in an aircraft scenario, this drops by 103 per year in when a second aircraft isn't available and the team respond by road. It remains the poorest performing scenario of the 4x merged base options.

When adding a twilight car shift to the current configuration, Welshpool also performs poorly with 68 less scene arrivals compared to Denbighshire. The twilight situation is explored in more detail in section 26.

Summary- a merged base in Welshpool gains 15 scene arrivals per year with a second aircraft, but drops by 103 per year with one aircraft. It remains the poorest performing merged scenario, with 68 less arrivals than Denbighshire.

11.7 Addition of a twilight shift to the current service configuration (2022)

All analysis to date, both internal and external suggests that if additional resource were introduced then it should be placed at 14:00 – 02:00 in order to maximise the impact on demand. Various staff asked why this hadn't been modelled.

The primary reason for not modelling this initially was due to an evident under-utilisation of current resources in Mid and North Wales, combined with a known skill fade issue, and recruitment and retention issues. The latter is in part evidenced by the current hybrid model, and earlier 5-day Welshpool service and delays in introducing Caernarfon. These factors alone would make it difficult to make a sound business case to add additional resource, which may be

difficult to provide, would be unsustainable, and overall reduce the activity of the two existing bases, further compounding the pre-existing issues. In addition, road response modelling at every stage has shown that the current bases provide poor road response capability, and result in no response in many cases where there are patients that require the services of the team. Early and more recent work evidence that a North Central location enhances the road response and provide improvements in equity of access.

We did however ask Optima to run this additional scenario, labelled as "10", giving them the freedom to select the most appropriate location and timing for such a shift, allowing comparison with any of the other scenarios, but predominantly the current situation (including Cardiff Day shift).

The results show that the best geographical location to meet the "new" unmet need (largely in the NE of Wales) would be a new site in Ruthin, and the best timing is 14:0 -02:00. This new site was modelled alongside existing sites and Denbighshire, and the latter came out as the best performing site (by +68 scene arrivals). It is noted that Ruthin has significant drive times for the majority of overall unmet need. The best performing scenario for an additional shift, would see up to 138 patients per year being attended. The best performing merged base scenario would see up to 387 patients per year attended.

Summary- an additional twilight RRV on top of the current service spec would see an additional 138 scene arrivals per year, which is 249 less than the optimum merged base scenario. This is likely due to the lack of air coverage during this additional shift as well as limitations of current site configuration.

11.8 "New Unmet Need"

Summary – with a net gain of scene arrivals, there is an unintended "new" unmet need within the existing demand. When reviewed in detail this is an estimated 11 trauma patients and 4 medical patients that would ordinarily receive critical care interventions. In terms of trauma, where there is known benefit, the optimum scenario would see a net gain of 174 trauma patients in the extracted dataset.

In order to determine the new unmet need, i.e. those cases that are now not responded to within the simulations, that would have ordinarily received a response from the existing bases that are proposed to be merged, the exported optima dataset was linked with WAST CAD data, EMRTS operational data and reference data to enable individual cases to be identified[10].

In the scenario of poor weather, with no flying capability across all bases (scenario 8B) for a 12-month period, there are 90 such incidents, with 42 being of a medical nature, and 28 being Trauma related. This represents a worst-case scenario and the real impact would likely be lower. Scenario 6 as an example (merged base, 6 months of second helicopter) reveals 52 cases per year (20 Medical, 32 Trauma) not receiving a response. If we further adjust this to those that received a critical care intervention this is 7 Medical and 15 Trauma patients per year (22 total). Further filtering to reveal those cases that reside in Mid, North or West Wales reveal the total to be 15 patients (4 medical, 11 trauma).

[10] Please note due to the nature of the simulations and running up to 10 random seeds, this is a snapshot, and absolute figures cannot be compared to others presented in the report. The relative change however is valid.

Quantifying potential mortality or morbidity within this groups is difficult without reviewing outcome data and controlling for case presentations but based on the best current knowledge and evidence base, the service provides a mortality benefit to trauma patients, and the optimum base scenarios increase the number of trauma patients attended by the service (by 174 in an extracted sample).

Opitma_Trauma or medical	Medical		Trauma		**Total**	
Locality	n	CCI	n	CCI	**n**	**CCI**
Gwynedd	3		6	6	**9**	**6**
Bridgend	1		4	2	**5**	**2**
Cardiff	1		4	4	**5**	**4**
Swansea			5	4	**5**	**4**
Wrexham	1		3	2	**4**	**2**
Carmarthenshire	2	3	1		**3**	**3**
Isle of Anglesey	2	1	1		**3**	**1**
Caerphilly	1	1	1		**2**	**1**
Ceredigion	1		1	1	**2**	**1**
Flintshire	1	1	1		**2**	**1**
Neath Port Talbot	1		1		**2**	
Blaenau Gwent	1				**1**	
Conwy			1		**1**	
Denbighshire	1				**1**	
Merthyr Tydfil			1	1	**1**	**1**
Newport	1				**1**	
Pembrokeshire			1		**1**	
Powys	1				**1**	
Rhondda Cynon Taf	1	2			**1**	**2**
The Vale of Glamorgan			1		**1**	
Torfaen	1	2			**1**	**2**
Total	**20**	**10**	**32**	**20**	**52**	**30**

Figure 19 New unmet need all Wales

In the scenario above, some of these are during the peak period in the afternoon, and one other area that is of concern is the reduced coverage for North Wales in particular between 8am and 14:00, when there is one resource compared to two at present. To test this we have filtered scenario 6 and 1 to look at the new unmet need between these hours on an all Wales basis (Figure 20), and North/ Mid Wales (Figure 21) . This are a proportion of the above figures (i.e. not in addition) and relate to 14 cases per year, of which 17 required a critical care intervention (12 Trauma).

Opitma_Trauma or medical Locality	Medical		Trauma		**Total**	
	n	CCI	n	CCI	**n**	**CCI**
Gwynedd	2		4	3	**6**	**3**
Cardiff			2	4	**2**	**4**
Flintshire	1	1	1		**2**	**1**
Neath Port Talbot	1		1		**2**	
Swansea			2	2	**2**	**2**
Wrexham			2	2	**2**	**2**
Bridgend			1		**1**	
Conwy			1		**1**	
Denbighshire	1				**1**	
Isle of Anglesey			1		**1**	
Merthyr Tydfil			1	1	**1**	**1**
Newport	1				**1**	
Powys	1				**1**	
Rhondda Cynon Taf	1	2			**1**	**2**
Torfaen	1	2			**1**	**2**
Total	**9**	**5**	**16**	**12**	**25**	**17**

Figure 20 New unmet need (08:00-14:00)

Opitma_Trauma or medical Locality	Medical		Trauma		**Total**	
	n	CCI	n	CCI	**n**	**CCI**
Gwynedd	2		4	3	**6**	**3**
Flintshire	1	1	1		**2**	**1**
Wrexham			2	2	**2**	**2**
Conwy			1		**1**	
Denbighshire	1				**1**	
Isle of Anglesey			1		**1**	
Powys	1				**1**	
Total	**5**	**1**	**9**	**5**	**14**	**6**

Figure 21 New unmet filtered to North/ Mid Wales (08:00-14:00)

11.9 Context of current operation

Previous work that informed the latest position are included here to give further context to the proposals.

11.9.1 Pattern of deployment

11.9.1.1 Road responses from current bases

Summary: in the current base configuration, the numbers of local responses are relatively low, and in addition other resources routinely respond into these areas (171 times per year).

In an attempt to review the current situation in relation to road responses from Welshpool and Caernarfon (i.e. the advantage of having a local presence) we have summarised all road calls attended by base over 12 months by locality. There is a count of unique days as well as unique incidents. This to give context to the simulations, in which a response may now have been sent from one of the other bases by road or air. Please note where small counts occur in distant locations that this may be due to miscoding of base location in the CAD at the time of call (i.e. may be the opposite base responding to that specific call).

Response Mode Locality	Rapid Response Vehicle days	 Incidents
Conwy	2	2
Denbighshire	2	2
Flintshire	2	3
Gwynedd	2	2
Isle Of Anglesey	1	1
Powys	44	49
Wrexham	11	11
Total	**59**	**70**

Figure 22 Welshpool road responses

Response Mode Locality	Rapid Response Vehicle days	 Incidents
Conwy	13	15
Denbighshire	3	3
Flintshire	1	1
Gwynedd	41	45
Isle Of Anglesey	13	13
Wrexham	2	2
Total	**62**	**79**

Figure 23 Caernarfon road responses

11.9.1.2 Other bases responding into north/ Mid Wales

It is also worth noting that currently Dafen and Cardiff responded to 171 cases in Mid and North Wales last year as per making up 19% of activity, a proportion of which would now be serviced by the proposed model (e.g. 55 cases were during the hours of 19:00 and 02:00, and 156 during the proposed total merged base hours).

refLocality	n
⊞ Ceredigion	65
⊞ Powys	58
⊞ Gwynedd	22
⊞ Denbighshire	8
⊞ Wrexham	7
⊞ Conwy	5
⊞ Flintshire	3
⊞ Isle Of Anglesey	3
Total	**171**

Figure 24 H57 & H67 responses into North/ Mid Wales

11.9.1.3 Removal of the 02:00 backstop for shifts

Summary: a full night shift would deliver 8 additional scene arrivals per year, however it would disadvantage rural areas during peak periods.

The 02:00 backstop was included in the optima modelling, based on a combination of previous internal analysis revealing maximum coverage of unmet need, including the peak periods of 15:00 and 21:00, and advice that later finishes may have operational limitations from the aviation perspective. Feedback from staff was that a full night shift should be explored to satisfy concerns that a partial shift may be contrary to the mission statement, but also may be more acceptable to some staff in terms of impact on other employment commitments.

Optima were therefore instructed to remove this 02:00 limitation and explore the results.

The results reveal a minor improvement of 8 scene arrivals per year for a 19:00 -07:00 shift, compared with the proposed 14:00- 02:00 shift. It reveals slightly fewer scene arrivals within 14:00 – 19:00 period. Thus decisions around twilight versus a full night shift, whether utilising additional resource or existing resource are informed by other factors.

Scene Arrivals (Count)	A daily, 12-hour car-only shift was added to the merged Denbighshire base at:																							
	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
3D car) Denbighshire	2,897	2,886	2,871	2,858	2,849	2,843	2,846	2,826	2,843	2,872	2,905	2,912	2,931	2,947	2,960	2,960	2,964	2,967	2,967	2,968	2,962	2,956	2,936	2,910

Figure 25 24-hour optima modelling for North/ Mid Twilight scene arrivals

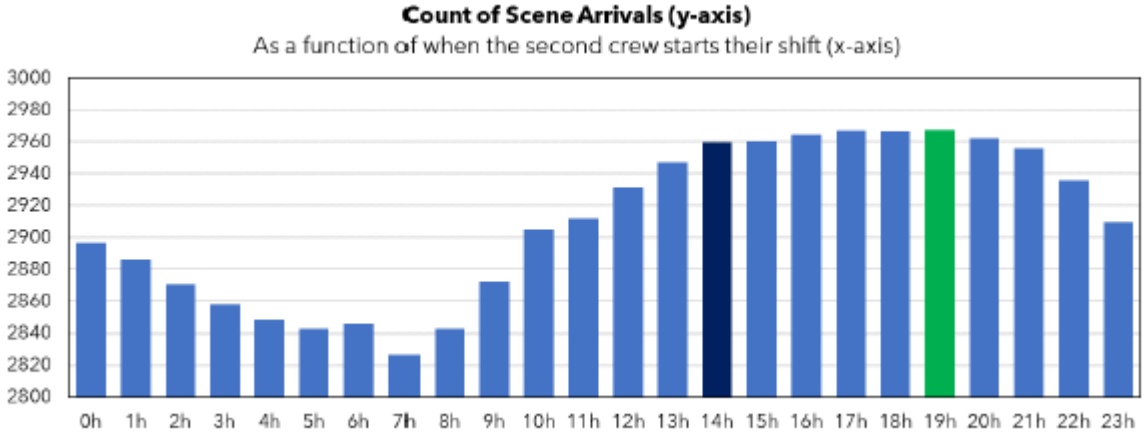


Figure 26 graphical representation of scene arrivals

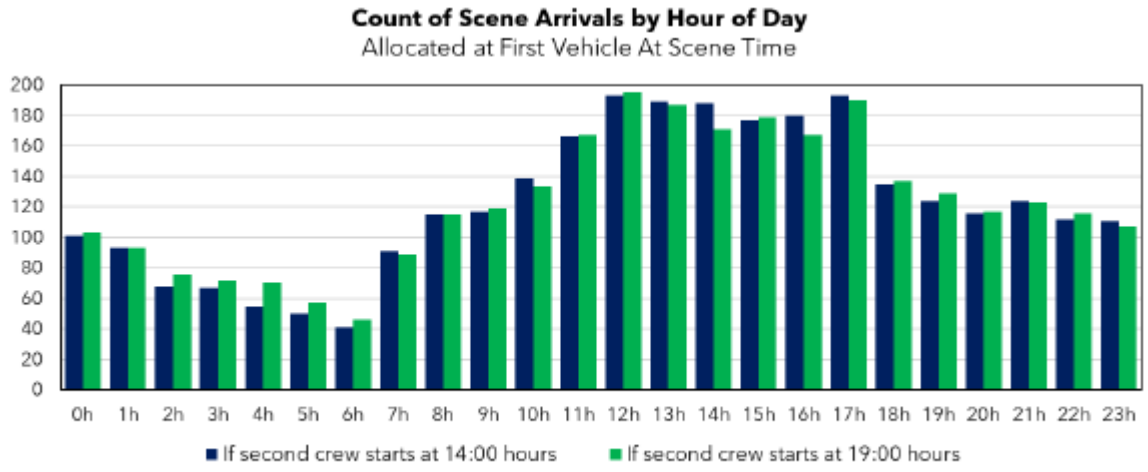


Figure 27 night shift vs twilight shift scene arrivals

11.9.1.4 Drive time data

Summary- Drive time data has been rigorously examined previously, and the new optima model also includes recent emergency response data. 99% of the Welsh population can be covered within 90 minutes' drive of a 3-base model.

The drive time data is included below, from earlier work conducted by Swansea University. Whilst we didn't repeat this work with fresh data, Optima have more up to data WAST travel time data, which includes real EMRTS RRV responses as well as WAST RRV responses. The tuning work done with the optima model revealed good concordance between simulation and real life, and so we have confidence in the road travel time data. Of note, the travel time data is context specific and takes into account the variation seen in traffic when compared to static GIS drivetime isochrones. We feel that a model tuned with in excess of 5 million 999 responses is the most appropriate way method compared to commercial travel data, albeit a smaller sample.

Extract from previous work for reference.

11.9.1.5 EMRTS 24/7 Travel time modelling

Road

GIS modelling was conducted to identify the distance that could be reached by road response from current air ambulance bases and an additional forward location identified by the operational management team Glan Clwyd hospital. The population coverage was then calculated for 30, 60 and 90-minute isochrones. In addition two combined scenario were modelled.

Population coverage based on a total population of 3,113150 are detailed in Figure 28Figure 28 Population coverage

SCENARIO	30 MINS	%	60 MINS	%2	90 MINS	%3
GLANCLYWD, CARDIFF, DAFEN	**2136070**	**69%**	**2892550**	**93%**	**3087190**	**99%**
CAERNARFON, DAFEN, CARDIFF	**1915320**	**62%**	**2600620**	**84%**	**3059750**	**98%**
CAERNARFON	106064	3%	354833	11%	731599	24%
GLAN CLYWD	326813	10%	646759	21%	733470	24%
CARDIFF	1217530	39%	2023200	65%	2145440	69%
DAFEN	603183	19%	2087130	67%	2353720	76%
WELSHPOOL	51948	2%	162614	5%	869642	28%

Figure 28 Population coverage

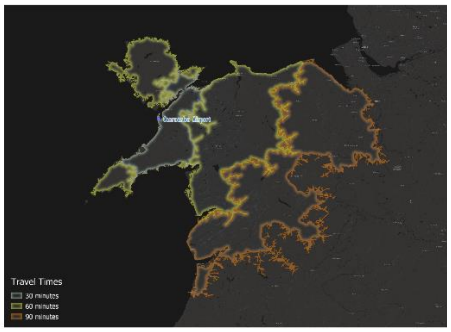


Figure 29 Road Travel isochrones from Caernarfon Airport

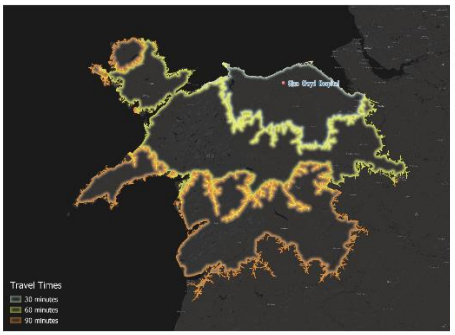


Figure 30 Road Travel isochrones from Glan Clwyd Hospital forward location

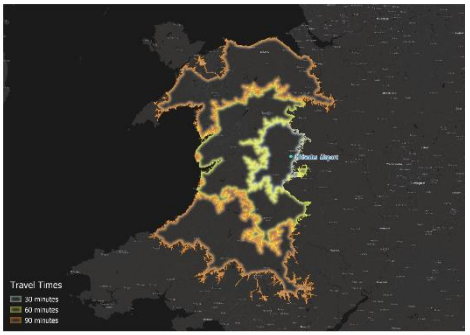


Figure 31 Road Travel isochrones from Mid Wales Airport (Welshpool)

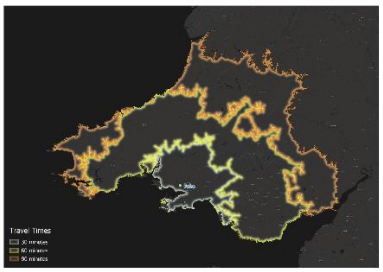


Figure 32 Road Travel isochrones from Dafen Airbase (Llanelli)

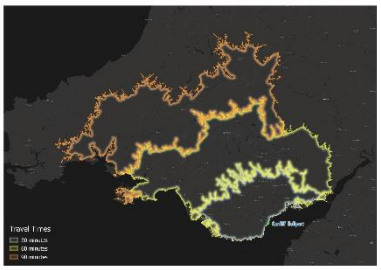


Figure 33 Road Travel isochrones from Cardiff Heliport

Figure 34 Road Travel isochrones from Caernarfon Airport, Dafen, and Cardiff

Figure 35 Road Travel isochrones from Glan Clwyd Hospital, Dafen and Cardiff Heliport

11.9.1.6 Measurable Benefits Register (2014)

	Benefit
Equity	1. Access to specialist care not available at patient's nearest acute hospital.
	2. Timeliness of access to specialist care for all patient groups.
	3. Enhanced perception of equity by health care professionals, Health Board representatives and patient representatives.
Health Gain	4. Improvement of patient functional outcome (two groups: Major Trauma, Cardiac Arrests).
	5. Reduction in mortality of various clinical conditions.
	6. Reduction in length of hospital stay.
	7. Critical care intervention or any decision outside of standard paramedic practice.
	8. Objective improvement in the clinical condition of patients.
	9. Downstream benefits in hospital.
	10. Avoidance of hospital transfer and emergency department admission.
	11. Enhanced perception of health gain by health care professionals, Health Board representatives and patient representatives.
Clinical & Skills Sustainability	12. Increased consultant appointments, especially in emergency medicine.
	13. Increased educational interventions to doctors/paramedics/ nurse practitioners /midwives

12 Appendix K WAA/EMRTS Service Analysis - Frequently Asked Questions[11]

Last updated: 06/09/2022

The following are questions that both the Wales Air Ambulance Charity and the Emergency Medical Retrieval and Transfer Service (EMRTS) have been asked about the ongoing service analysis, along with our responses.

For information about the service analysis, visit Air Ambulance could reach hundreds more patients thanks to analysis | Welsh Air Ambulance Charitable Trust (Walesairambulance.com)

This is a live FAQs page and it will be added to on a regular basis over the coming weeks and months.

We'd also like to share this video interview with Professor David Lockey (Emergency Medical Retrieval and Transfer Service National Director). In it, he addresses some of these misunderstandings and some of the key points about the service analysis.

How will you be able to attend certain parts of the county by moving your base further away? Surely, it would take longer to get to certain locations by air or by road?

This is a critical question and it can only be answered by first understanding the specifics of an air ambulance operation.

With only four helicopters (and complementary Rapid Response Vehicles), and four highly skilled medical crews, we are a scarce resource. There is a complex range of factors which are taken into consideration for every single deployment of our pan-Wales fleet. Dedicated allocators and clinicians in our Critical Care Hub assess every incident on a case-by-case basis to provide the most appropriate response using our resources, in conjunction with other emergency response teams we work closely with.

Therefore, even though each air ambulance crew is based in a certain region, their response can be pan-Wales. None of our crews are restricted to a certain area of Wales, they move around the country attending missions as required. It's about sending the most appropriate available crew, regardless of where they are based. For example, if a life or limb-threatening incident were to occur in a remote rural area of Mid Wales, it could be attended from any of our current base locations (Welshpool, Dafen, Cardiff or Caernarfon).

Why is this important? People have raised concerns about the increased travelling times because of the proposed service reconfiguration. The reality is that this already happens, quite regularly, as part of our Service and with no detrimental effect to the patients and their outcome.

[11]Extracted from https://www.walesairambulance.com/Pages/FAQs/Category/waaemrts-service-analysis-frequently-asked-questions 22/10/22

Of course, helicopters can cover large distances rapidly and directly. However, some may ask how this is possible in a road vehicle when there, logically, would be increases in travelling time against the backdrop of an already difficult road network.

In reality, Wales Air Ambulance/EMRTS attends very few missions in an RRV from its Welshpool and Caernarfon bases as it currently stands. A vast majority of their work is by air. Why? Because these locations do not lend themselves well to any kind of road response. They are remote locations with poor access to a suitable road infrastructure, which means availability is significantly reduced. This is in addition to environmental factors, particularly in Welshpool with recurring flooding of the airbase and the surrounding road network.

To put the above into context, over the past 12 months 38% of the emergencies we attended in Mid Wales were done so by our crews in either North Wales or South Wales. Also, 74% of emergencies attended by our Welshpool crew were either in North Wales or South Wales. This clearly demonstrates that our resources are national assets that travel across the country to offer our advanced lifesaving care.

Questions about response times are completely understandable but we hope this offers reassurance that distances are not an issue for patient care as we already respond to incidents in remote areas, such as Mid Wales, regularly, with resources from both South Wales and North Wales.

With the challenge faced by the Welsh Ambulance Service NHS Trust, particularly around response times, will the reconfiguration of Wales Air Ambulance/EMRTS further reduce our chances of gaining a timely ambulance response?

No. It's important to point out that Wales Air Ambulance/EMRTS is not a replacement for the Welsh Ambulance Service NHS Trust (WAST).

We are not part of the same organisation but we do work closely in partnership. Wales Air Ambulance/EMRTS attends the highest level of life or limb-threatening emergency calls (red and some amber). It is rare that Wales Air Ambulance/EMRTS attends an incident without a WAST presence. In the chain of survival, WAST medics are usually first on the scene of an incident or medical emergency and offer the all-important initial lifesaving interventions before our crew/s arrive and administer the emergency department-standard treatment that has been proven to increase the chances of survival (see our 2015-2020 Service Evaluation).

For context, WAST receives somewhere in excess of 600,000 calls per annum and responds to around 250,000 of these as an emergency response, and 40,000 as an immediate response. Unlike the Ambulance Service, which covers such a broad range of services, HEMS (Helicopter Emergency Medical Services) supports the highest acuity of life or limb-threatening conditions. Our detailed analysis of need has shown that somewhere in the region of 4,670 calls per year would benefit from the attendance of our critical care teams. We currently attend 72% of these nationally and the service analysis findings indicate that we can get much closer to meeting the total need – seeing an extra 583 patients and meaning that we would see 88% of those critically ill and injured patients that could benefit from our services.

Wales Air Ambulance/EMRTS is not sent to an incident or medical emergency by WAST. Within the WAST contact centre in Cwmbran is our Critical Care Hub, which is staffed 24/7 by an experienced allocator and critical care practitioner, both employed by EMRTS. They monitor the most serious 999 calls and automatically dispatch the most appropriate Wales Air Ambulance/EMRTS crews to those emergencies that we can add value to with our emergency department-standard critical care. On some occasions, emergencies can be worse than first reported, or a patient can rapidly deteriorate. When this happens, a WAST paramedic involved in the incident will contact our Critical Care Hub to ask for advice and, if required, medical backup. To learn more about our Critical Care Hub, please read this article written by Hub Manager, Greg Browning.

It is not just the Ambulance Service we work with. We try and work flexibly as a team with a range of other emergency care services. For example, our overnight crew will often switch to a road response, particularly in winter months, and may drive over significant distances, often intercepting ambulance crews to further improve time to definitive critical care. We have even been known to drive to a scene in poor weather in the middle of the night, rendezvousing with colleagues from the Search and Rescue bases who can fly in conditions that we are currently unable to. Ours is a complex and dynamic service, serving the whole of Wales and often having to balance a whole series of complicated operational, logistical and clinical judgements.

Again, it is vital to emphasise that Wales Air Ambulance/EMRTS is not a replacement for WAST. For the best patient outcomes, interventions from WAST and then Wales Air Ambulance/EMRTS are important.

The proposed WAA/EMRTS reconfiguration is actually a service expansion as it will increase our operational hours in the North of the country, meaning that people in both North and Mid Wales will benefit from our lifesaving care for more hours of the day and night.

You suggest that you can attend 583 more lifesaving missions a year. How did your analysis come to that figure?

The data which has generated the 583 figure has been derived from EMRTS' independent data modelling. Figures indicate that there are currently 1331 patients who, according to their clinical presentation and situation as logged on the Ambulance Service system, are patients our clinicians believe would benefit from WAA/EMRTS attendance and who currently are not seen for a variety of reasons. Reasons for non-attendance vary but it is predominantly because crews are already committed (at night this could be because a response would be needed from the Cardiff team) or because poor road capability means that if an air response is not possible there would be an unacceptable delay. Through the simulations run by Optima (over 200 simulations and 40 scenarios), we have identified the optimum base configuration and staffing pattern which enables us to treat both our existing patient base plus an additional 583 out of those 1331 which currently make up the unmet need. We can identify the projected location of these patients and see that not only do all parts of Wales see an increase in patients attended by WAA/EMRTS, no parts of Wales see a reduction in patients attended by WAA/EMRTS – there is a net benefit in all parts of the country.

A brief overview of the calculation process is as follows:

Calculation of total demand from 4-year average activity, combined with prospectively identified unmet need over 2 years.

Calculation of utilisation and activity by base, day, month, season, hour, including average incidents per day, and total time involved with incidents.

Optima models tuned to match real life, and then 200+ simulations run, with 41 best performing scenarios continued, and tested. This includes sensitivity analysis looking at all current base options, addition of resource, base moves, changes of shift times, and poor weather as well as road access.

Data extracted from Optima models, and linked back to NHS data.

'Deep dive' into the clinical impact of current and proposed patients.

Change in patients identified from this data by locality to give headline figures.

Are the 583 additional missions in the more densely populated areas of Wales – simply because of the increased density of population as compared to a rural area?

No. In fact, the per 1000 population data shows that some of the most significant improvements are in Powys. (as per the table below).

Locality	***PC change***
Conwy	+11%
Denbighshire	+15%
Flintshire	+18%
Gwynedd	+7%
Isle of Anglesey	+1%
Wrexham	+2%
Powys	+11%

Carmarthenshire	+6%
Ceredigion	+2%
Neath Port Talbot	+15%
Pembrokeshire	+14%
Swansea	+13%
Blaenau Gwent	+23%
Bridgend	+9%
Caerphilly	+11%
Cardiff	+17%
Merthyr Tydfil	+18%
Monmouthshire	+14%
Newport	+35%
Rhondda Cynon Taf	+16%
The Vale of Glamorgan	+17%
Torfaen	+16%

If the changes are implemented, what would be the impact on mission attendance at a regional level?

The changes would be universally positive. All regions of Wales will see an increase in mission attendance by WAA/EMRTS.

Please see below county-level information showing the percentage change in incidents attended (verses 2021 baseline), according to the service analysis modelling.

If the changes are implemented, what would be the impact on average response time over a 24-hour period (versus 2021 data)?

The negatives in the following table are improvements in minutes.

As the table indicates, there are no increases in average response time for any region across Wales.

Locality Average reflex* time (mins)	Change) minutes
Denbighshire	-41
Flintshire	-36
Conwy	-32
Wrexham	-28
Isle of Anglesey	-13
Gwynedd	-14
Ceredigion	-15
Carmarthenshire	-12

Cardiff	-12
All Wales	-11
Pembrokeshire	-10
Torfaen	-13
Neath Port Talbot	-10
Swansea	-8
The Vale Of Glamorgan	-9
Bridgend	-9
Merthyr Tydfil	-10
Powys	0
Blaenau Gwent	-9
Newport	-8
Rhondda Cynon Taf	-9
Caerphilly	-7
Monmouthshire	-5

*Reflex time is allocation of a resource to arriving on scene.

There has been a lot of information and commentary about North and Mid Wales. How will the proposed Service model impact South Wales?

All counties of Wales will positively benefit from the proposed changes highlighted in the service analysis. We could see even more patients in South Wales, and get to incidents/emergencies even quicker on average than we currently do.

County-level information for South Wales showing the percentage change in incidents attended (verses 2021 baseline), according to the service analysis modelling.

Is it true to say that those in populated areas are in less need of Wales Air Ambulance/EMRTS than rural areas due to increased Ambulance Service provision and closer proximity to hospitals?

Absolutely not. Wherever you are in the country, the out-of-hospital emergency-department standard treatments only offered by Wales Air Ambulance/EMRTS, could be the difference between survival at the scene or not, even before getting to hospital, regardless of how close that hospital may be. Also, the nearest hospital may not be the most appropriate hospital for the patient's needs. If WAA/EMRTS did not attend such an incident and a patient was conveyed to the nearest hospital, there is a possibility that a secondary transfer would be required to a more suitable healthcare facility. This could take several hours to arrange and undertake, further diminishing the chances of survival and long-term recovery. As well as the advanced critical care capabilities we bring to an incident, our medics can diagnose the underlying issues of a patient and transfer them directly to the most appropriate hospital – whether in a WAA helicopter or, if the patient is unstable or the weather is poor, in a Welsh Ambulance Service NHS Trust road ambulance. On some occasions, we may use a Search and Rescue helicopter. This ensures that the patient receives the required next level of specialist care as quickly as possible, increasing the chances of long-term survival and recovery.

Therefore, Wales Air Ambulance/EMRTS attendance is equally as important in an urban setting as it is in a rural environment.

Is this just a cost-cutting exercise?

No. These proposals are not, and never were, designed to produce financial savings. They are solely focused on improving patient outcomes.

Our service evaluation, published in March 2022, proved that we deliver an excellent standard of care for the people of Wales. More people are surviving because of our advanced lifesaving service. Now we want to know whether we are delivering this excellent care equitably, and to as many people as possible, with our current resources. The funding we receive is from you, the people of Wales, and we have a duty to you to ensure that we are using it in the most efficient and effective way.

The efficiency and effectiveness of the Service is particularly important now as the global economy is changing dramatically, through an increase in the cost of goods and services. The Charity is expecting a very significant increase in aviation costs, potentially increasing our bill by several million pounds per annum.

Is this just a target-driven exercise?

Absolutely not. We are not a target-driven organisation when it comes to missions attended. We just want to make sure that as many people are benefiting from our lifesaving Service as equitably as possible – something we know you care about too.

The collaboration between the Wales Air Ambulance Charity and EMRTS is founded on improving the outcomes of patients, and this has been proven in our recent service evaluation. This is the foundation of the current service analysis, in a bid to see more patients receiving the care they require, with more lives saved, and improved long-term outcomes for the people of Wales (i.e. an effective critical care response which facilitates faster recovery times and a better quality of life, long-term, for patients and their families). Continuing with the status quo would see poorer outcomes or deaths across Wales, in patients where we know we could have a positive impact. This includes rural areas, especially out of hours.

Your model recommends that the current crews at Welshpool and Caernarfon should co-locate on one base in a North Wales location. Did you consider your current Welshpool base as a potential co-location site?

Yes. As part of a suite of over 200 simulations, Welshpool was included at every stage and combination of models, even when it was identified as poorly performing early on. Part of the reason that Welshpool was consistently shown to be a sub-optimal option relates to its geographical positioning and road connectivity, meaning availability is significantly reduced. This is in addition to environmental factors and operational days lost due to recurring flooding of the airbase and the surrounding road network. Putting additional resources into this location would deliver little benefit and mean that the crew would do very few missions from the base (in Powys and beyond).

What is the approximate timescale for getting all helicopters equipped for night flying, given the priority on saving more lives across the country?

With a year to go on our existing aviation contract, it is likely something we would make a priority for the new supplier/new contract. Essentially there are three components to being able to fly using night-vision capability:

The aircraft being fitted with the right technology.

The availability of night-vision goggles for each of the pilot team/crew members who need them.

Pilots and crew being initially trained and then training standards maintained throughout the period of employment/tours of duty to ensure they remain current in terms of their night-flying accreditation.

With our current mixed fleet and operating model, it is the last of these which adds quite a lot more complexity. By including this requirement in our new contract, the successful supplier will be able to plan and price for this from the outset. In addition, our new contract will see us move to a single airframe type and more consistent crewing model which will help achieve this. We are awaiting the evaluation/analysis of responses from our bidders in terms of timescales but the requirement we set out was for this to be part of the contract from the start. However, the rigour of the regulations in relation to night-vision flying and the oversight and conditions required by the CAA means that the reality is this will probably be some months after the start of the contract before we are fully operational.

Although, it is important to remember that all our aircraft are currently able to land at lit landing sites at hospitals and that our Cardiff-based overnight aircraft is fully night-vision operational.

Can you confirm what discussions you've had with the Civil Aviation Authority regarding a new base and the hours that pilots will be able to fly for, especially with the new night-time flights in North Wales?

Discussions with the CAA are the responsibility of the Air Operations Certificate holder, and will be for the new operator in 2024 to address. We have communicated our proposals for extended hours to those companies participating in our aviation procurement process and no concerns have been raised. Likewise, our aviation consultants can see no issues.

Why does the Charity want to remain independent?

The Wales Air Ambulance Charity believes that it is in the best interests of Wales to have an air ambulance operation that works in medical partnership with the NHS but is independent in its income generation and decision-making. This independence, outside of the pressures and constraints of public sector funding, allows the Charity to focus on its core services, continually monitor and effectively adapt to the critical care needs of Wales in a timely manner, while maintaining a consistently high standard of care.

The third sector and public sector partnership adopted in Wales is a model that has proven benefits for patients and their families, as well as for the NHS.

This rationale for remaining independent is shared by all air ambulance charities across the UK.

How much has this analysis cost the Charity?

The Charity has not spent any money on the analysis. It has been conducted by our medical partners, the Emergency Medical Retrieval and Transfer Service (EMRTS), with independent modelling included.

If you move from Welshpool, are we more likely to get a response from Midlands Air Ambulance?

Not as a result of the proposed reconfiguration. Wales Air Ambulance will continue to serve Powys as we always have – but with an enhanced service that could attend more lifesaving missions in the County (+11%) and with an additional overnight resource.

As is the case now, our friends and colleagues in Midlands AA would only attend an incident in Wales at our request and likewise, we would support them if they requested and we have a team available.

Here is a summary of the process behind cross-border air ambulance support. All 999 calls in Wales are received and logged within Wales. Therefore, our air ambulance colleagues across the border would not see Welsh 999 calls. Wales Air Ambulance has a dedicated 24/7 Critical Care Hub in the Welsh Ambulance Service Contact Centre (where 999 calls are received). Staffed by an Allocator and Critical Care Practitioner, the Hub team monitor all calls where a life or limb is potential threatened and, if there is an emergency that we could add value to, they will send the appropriate

available Wales Air Ambulance team (regardless of where in Wales they are based). On the rare occasions where we need cross-border support from another Air Ambulance Service, it would be our Critical Care Hub who would request this directly with them. This would only happen if our crews were already allocated to other emergencies or during a significant incident where multiple emergency resources are needed.

This cross-border aid is reciprocated as Wales Air Ambulance offers the same support for the same reasons in aid of our air ambulance colleagues who work alongside our border.

Your old key message was about being able to be anywhere in Wales in 20 minutes. Is this still a valid statistic in light of changing from a 'fast ambulance' to a 'flying emergency department'?

The concept of being anywhere in 20 minutes has become outdated and is not something that we have formally used in our materials in recent years. This was an important statistic pre the introduction of our consultant-led service in 2015, as we were essentially a 'road ambulance in the sky' and the key aim was to get a patient to the nearest hospital as quickly as possible.

Our current Service has completely changed the patient pathway as the initial focus is now on getting our advanced medical crew to the patient where the emergency-department treatment can begin, after which they take the patient directly to the appropriate specialist healthcare facility for their needs. Therefore, we have already dramatically reduced the time it takes for critically ill or injured patients to receive the advanced critical care they need.

Before our advanced Service came into being back in 2015, a patient was taken to the nearest hospital, which may not have been the best place for their needs, and then a secondary transfer would be required. As a result, it could have been several hours before a patient received the appropriate critical care (treatment that they now receive on our arrival at the scene) - if they survived to get to that point. Therefore, our Service has significantly reduced the time it takes for critically ill or injured patients to receive lifesaving treatment (by several hours in some cases), which is proven to improve survival rates. That is why the '20 minutes' statistic is no longer required and used.

13 Appendix L EASC SDP materials

The following materials are available online:

https://easc.nhs.Wales/commissioning/emrts/sdp/

Briefing Note

11 October 2022

EASC EMRTS SDP EASC Briefing 1 (PDF, 1.6Mb)

The purpose of this briefing is to let all stakeholders know the current position in the work to review the service development proposal developed by the Emergency Medical Retrieval and Transfer Service (EMRTS Cymru) and the Wales Air Ambulance Charity (WAAC), we will prepare further briefings as necessary.

Supporting documentation

11 October 2022

EASC EMRTS SDP Presentation (PDF, 1.9Mb)

The purpose of this presentation is to provide stakeholders with an overview of the EMRTS development proposal developed by the Emergency Medical Retrieval and Transfer Service (EMRTS Cymru) and the Wales Air Ambulance Charity (WAAC).

Frequently Asked Questions (online)