

Scottish Stroke Improvement Programme 2022: national report

A Management Information release for Scotland

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Main points

- There has been an increase in performance with brain imaging (89% in 2021 v. 86% in 2020) and aspirin initiation (92% v. 89%).
- There have been challenges with swallow screening (73% in 2021 v. 79% in 2020) and stroke unit admission (71% v. 77%). These negative changes are believed to be impacts of the COVID-19 pandemic.
- Thrombolysis door-to-needle (DTN) times have remained static compared to 2020, the national average (geometric mean) for DTN time was 52 minutes in 2021.
- NHS Tayside continues to perform very well against DTN time. NHS Greater Glasgow and Clyde has continued to find it hard to provide rapid assessments and treatments consistently across the multiple hospitals in their Health Board area.
- Transient ischaemic attack (TIA) clinic performance in Scotland has changed little between 2020 and 2021, although we do know that TIA services have often been delivered in different ways at different times during the COVID-19 pandemic.

Introduction

It is recognised that stroke is an important condition that can lead to death and disability. Stroke teams have continued to work very hard through 2021 to deliver the best possible care for their patients.

There are many evidence-based interventions that can lead to improved outcomes. Data from this audit informs efforts to improve these outcomes, with ongoing work from the Scottish Stroke Improvement Programme team driving forward progress in all Health Board areas and allowing best practice to be shared across Scotland.

About this report

In this year's report you will see the welcome return of the 'Outcomes' section. The focus is on 'Home Time' which is an interesting concept which is impacted on by many internal and external factors. It is hopefully an important measure for stroke survivors and one which we intend to continue to report on annually.

There has also been expansion of the data produced and reported in collaboration with colleagues from the Scottish Ambulance Service (SAS). Their contribution to the thrombectomy service in Scotland is highly valued and data from their service will help inform and improve performance of the acute stroke centres in coming years.

Future considerations

Going forward, the stroke audit will continue to develop. The audit will need to respond to changes laid out in the **Progressive Stroke Pathway**. Core elements of the audit will not change but reports in future years will see significant additions, especially around thrombectomy and the TIA bundle.

Results

The effect of COVID-19 on stroke services in NHSScotland

In this section we look at how the COVID-19 pandemic affected stroke unit admissions, capacity and the stroke unit standards in 2021.

Figure 1: Number of strokes from Scottish Stroke Care Audit (SSCA) and SMR01 (Lines) and number of emergency admissions (area) by date

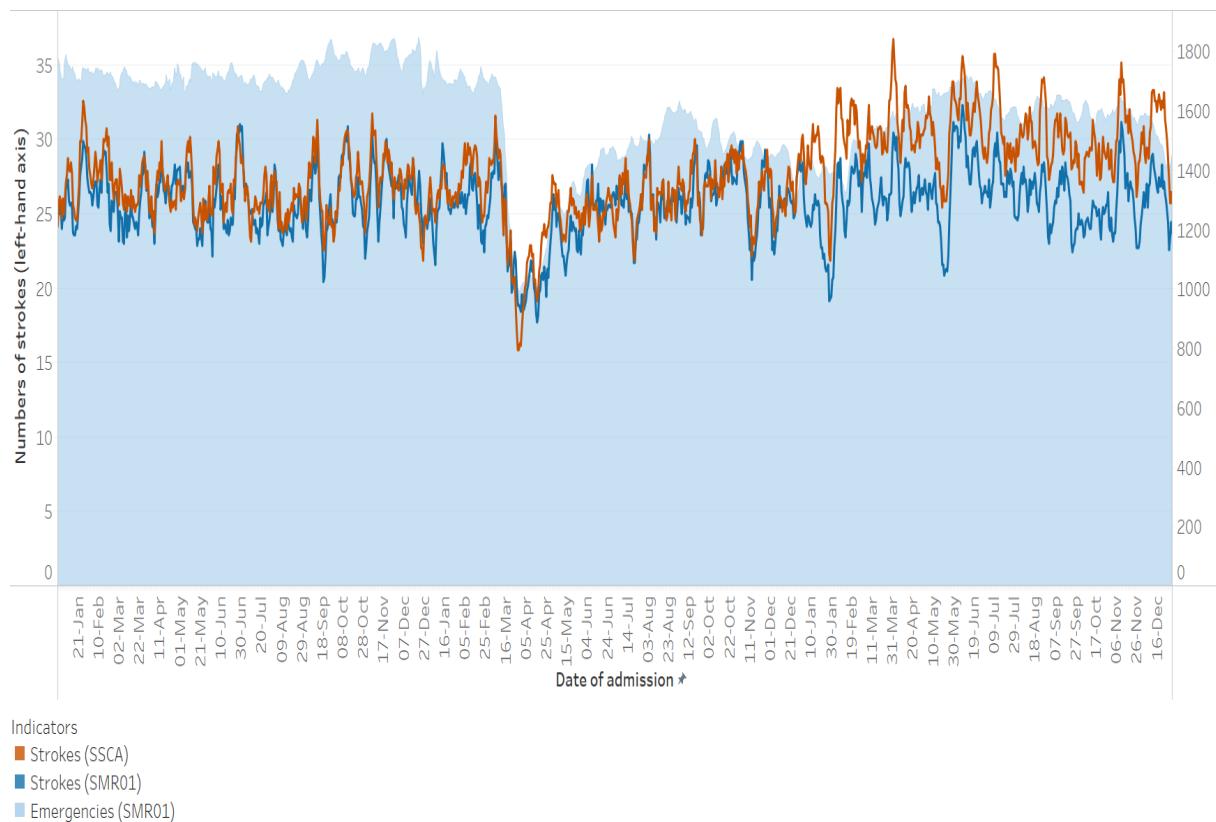
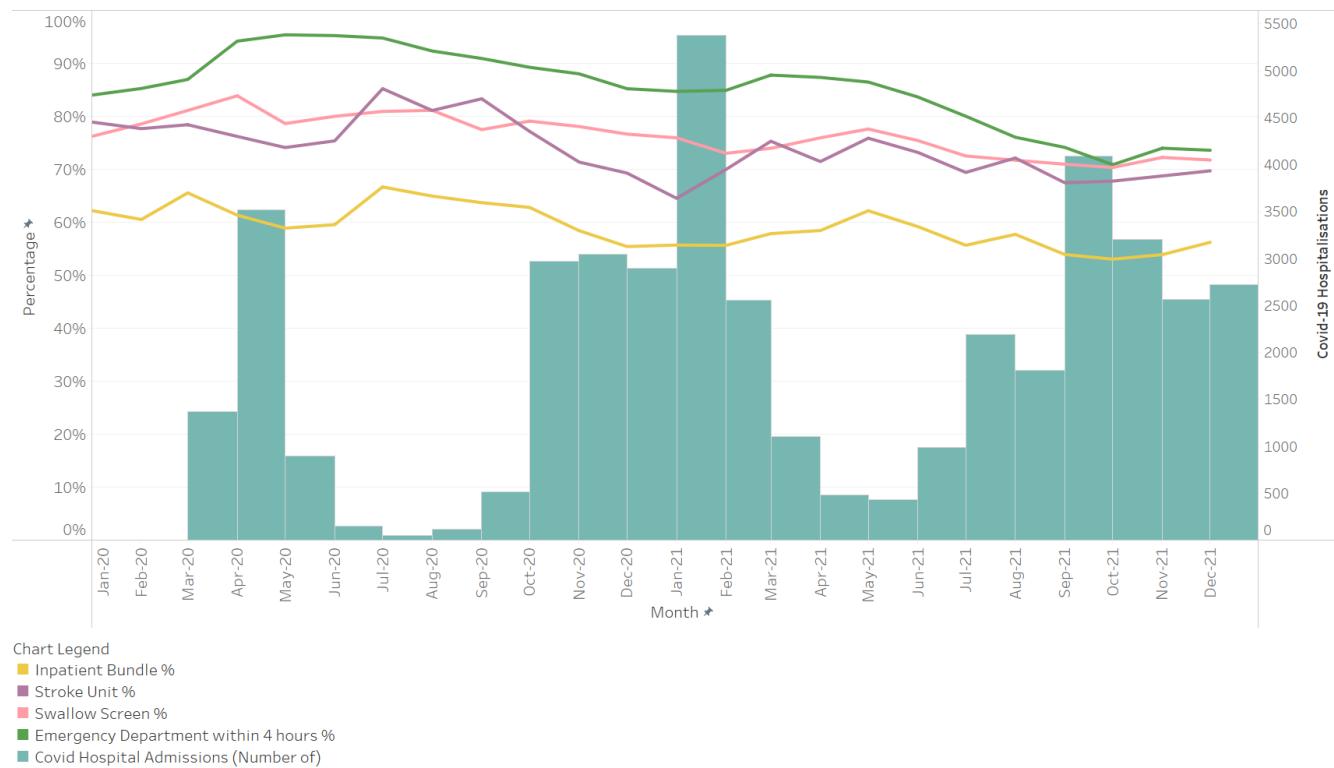


Figure 2: Stroke patients achieving inpatient stroke standards (2020–2021) compared with emergency department attendances treated with 4 hours and COVID-19 hospital admissions



Stroke admissions

In previous reports we have spoken about the impact the COVID-19 pandemic has had on stroke services. This has often been a very clear and direct effect of the waves of COVID-19 on hospitals.

Stroke admission numbers often fell during the early waves of the pandemic, when we presume that people with strokes avoided seeking medical attention. This is shown in Figure 1 (orange line) with falls in stroke admissions (and all emergency admissions) occurring most clearly in spring 2020 but also in winter 2020 and, to an extent, in winter 2021.

Stroke standards

Performance against the various standards also tended to deteriorate during each wave, recovering towards baseline as the number of inpatients with COVID-19 fell. This was most clearly seen in spring 2020, the first COVID-19 wave (see Figure 2).

During 2021, we have seen a much broader effect of the pandemic on hospital and stroke services. At times, stroke services across Scotland will have suffered stroke unit closures because of outbreaks among patients and staff. In hospitals where patients were cared for in stroke units, which did not have predominantly single-room accommodation, there were issues around COVID-19 contacts and isolation. This meant that even when the stroke unit was open, beds were, by necessity, left empty (blocked) and the capacity was reduced.

Delayed discharges

In the early phase of the pandemic, efforts were made to create capacity for sick COVID-19 patients and delayed discharges fell to very low levels. Since then, the number of delayed discharges has doubled, and this has had impacts on flow throughout the hospital.

Social care partners have had limited capacity to provide personal care packages because of staff absence for infection, isolation, shielding, burnout or resignation. Within the hospital there have been similar staffing reductions, leading to increasing pressures on the clinical teams.

The issues with hospital ‘flow’ (the ability to move patients to the correct place for their care needs and then discharge them at the appropriate moment) are perhaps best reflected in the ‘emergency department 4-hour wait’ standard. This standard says that no patient should spend longer than 4 hours between arriving at the emergency department and admission, discharge or transfer. This applies to all medical and surgical specialties.

Some of this performance may be impacted on by emergency department issues, such as staff absences with COVID-19 infection, but are believed to reflect whole

hospital flow and systems more generally. When it is not possible to admit patients to downstream beds, the emergency department performance deteriorates.

Figure 2 shows there was a modest improvement in emergency department 4-hour wait performance (green line) during the first COVID-19 wave in spring 2020. This will have been the time when emergency presentations fell significantly, and large efforts were made to create capacity for the expected wave of COVID-19 admissions. Flow was briefly very good and the emergency department 4-hour wait performance was around 95%. Since then, there was a steady deterioration in performance to the end of 2021, when the 4-hour wait performance was just over 70%.

Stroke bundle

Figure 2 shows two of the standards that make up the stroke bundle. Swallow screening (pink line) and stroke unit admission (purple line) are linked to 4-hour emergency department waits in different ways.

To succeed in the 4-hour swallow screen standard, people need to be very quickly assessed at the front door. This has become increasingly difficult to do for all patient groups, not just stroke.

For patients to get to a stroke unit bed rapidly, hospital flow needs to be working well. Figure 2 shows how closely 4-hour waits, and these two stroke standards are associated.

Aspirin initiation and brain imaging

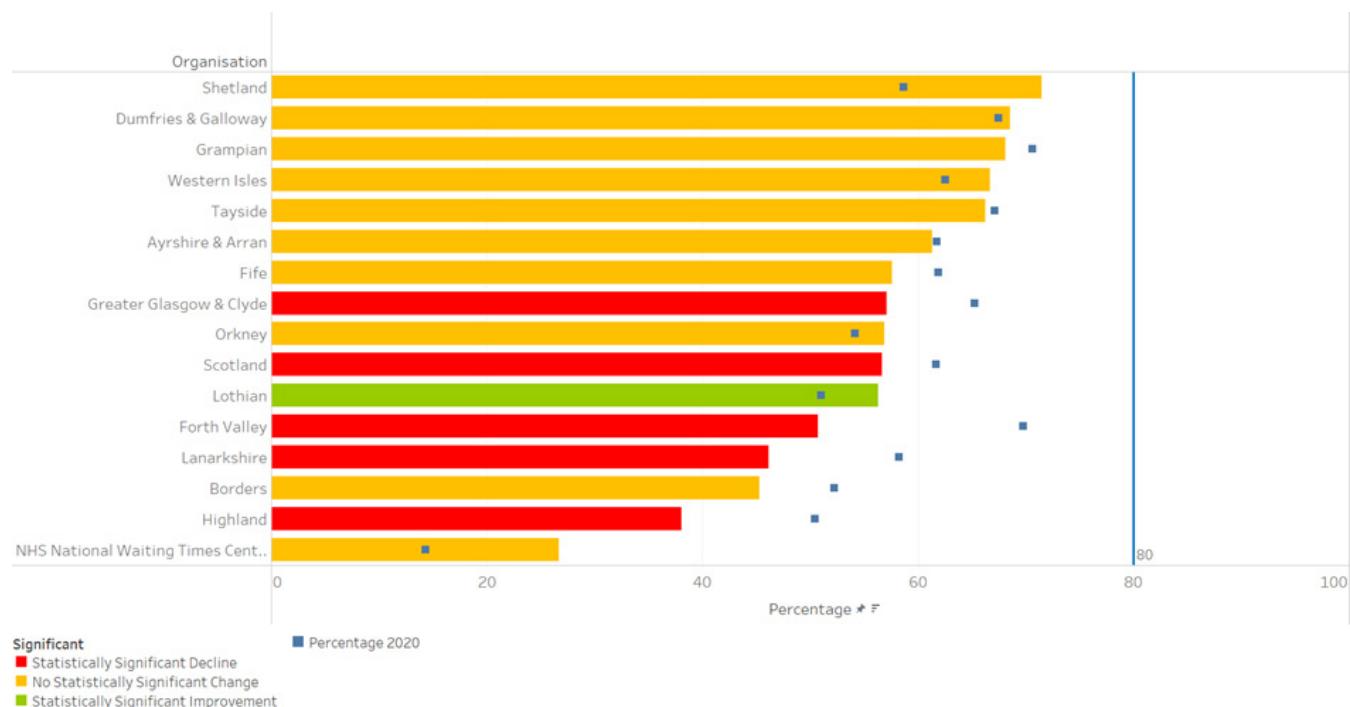
Aspirin initiation and brain imaging are less directly impacted on by emergency department and hospital flow issues. They have remained stable over the last 12 months (and in fact have slightly improved).

Discussion

While efforts to maintain performance against the stroke bundle continue in all stroke services across Scotland, we recognise that other hospital factors directly impact on

this performance. It will only be as we see normalisation of whole-system hospital performance, as we rebuild after the COVID-19 pandemic, that stroke services can truly make progress into rebuilding performance and then improving on the pre-pandemic picture.

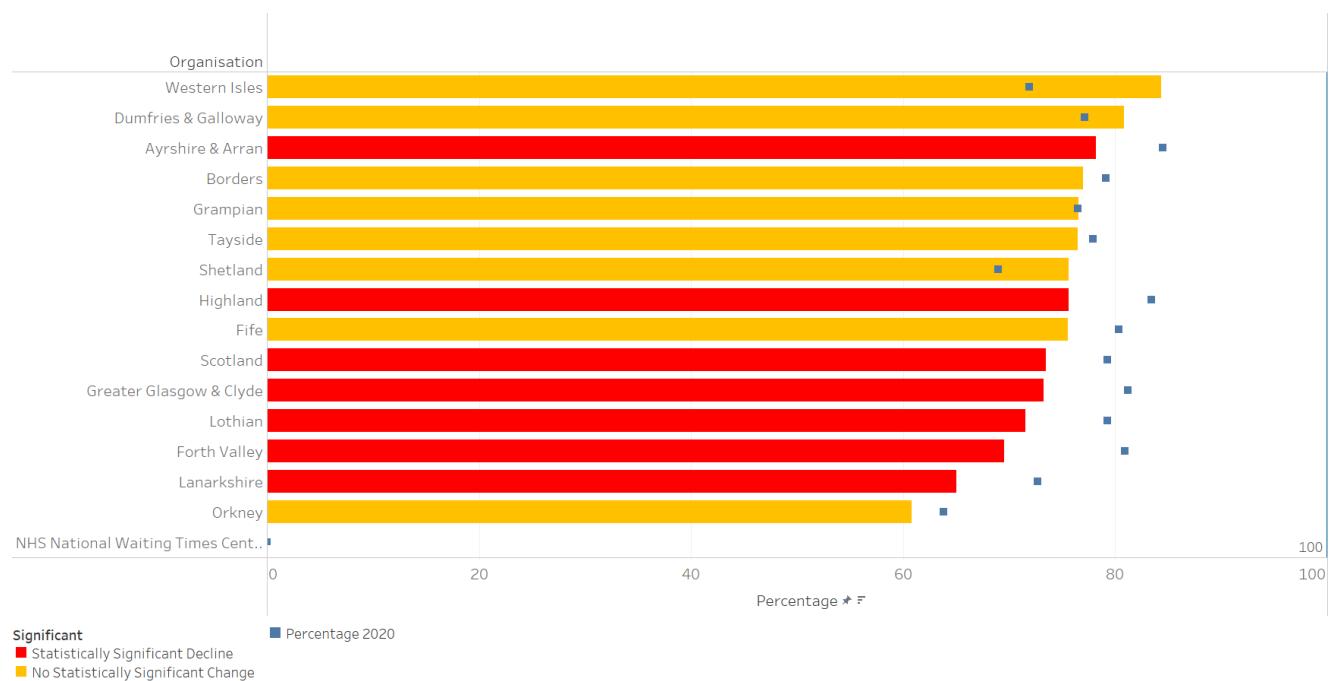
Figure 3: Stroke patients receiving the appropriate stroke bundle by Health Board: 2021 (bar) compared to 2020 (square)



Statistically significant decline in NHS Greater Glasgow and Clyde, Scotland, NHS Forth Valley, NHS Lanarkshire, and NHS Highland.

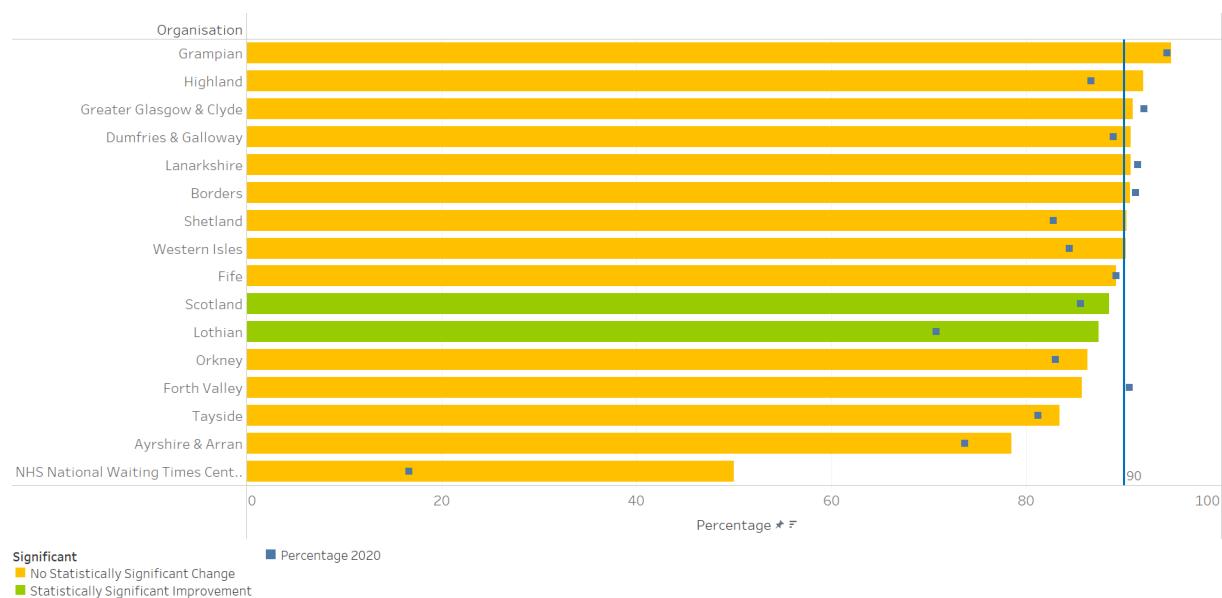
Statistically significant increase (to an average level) in NHS Lothian.

Figure 4: Stroke patients receiving swallow screen within 4 hours by Health Board: 2021 (bar) compared to 2020 (square)



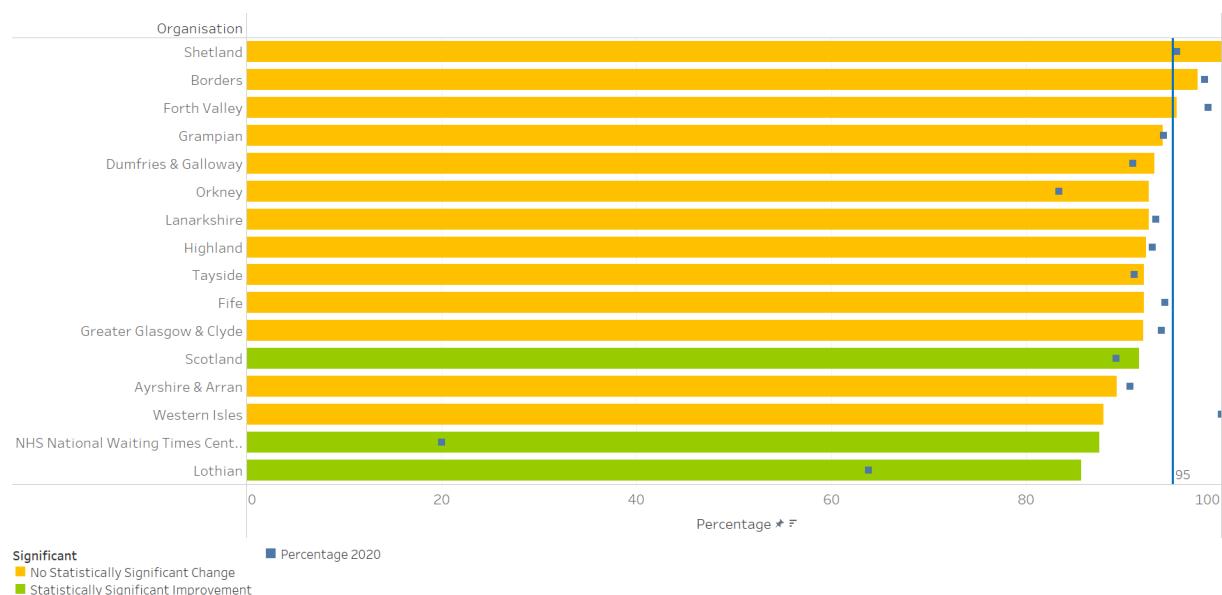
Statistically significant decline in NHS Ayrshire and Arran, NHS Highland (although above the average), Scotland, NHS Greater Glasgow and Clyde, NHS Lothian, NHS Forth Valley and NHS Lanarkshire.

Figure 5: Stroke patients receiving brain imaging within 12 hours by Health Board: 2021 (bar) compared to 2020 (square)



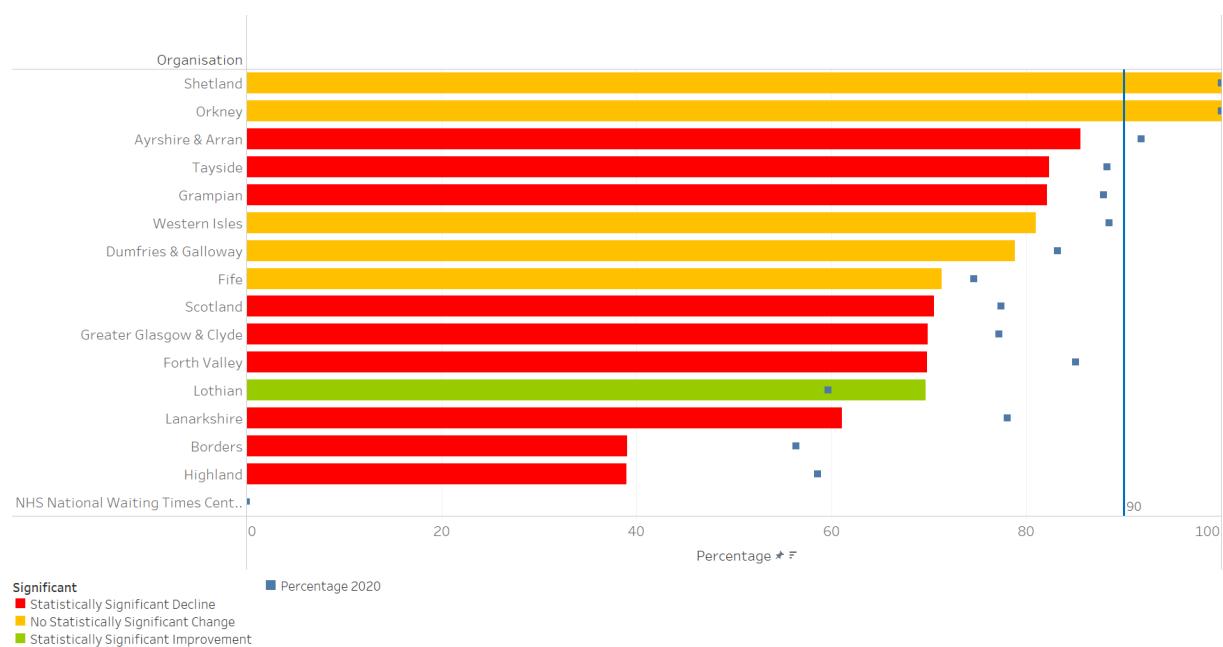
Statistically significant increase in Scotland and NHS Lothian.

Figure 6: Stroke patients receiving aspirin within 1 day by Health Board: 2021 (bar) compared to 2020 (square)



Statistically significant increase in Scotland, NHS National Waiting Times Centre and NHS Lothian.

Figure 7: Stroke patients being admitted to a stroke unit within 1 day by Health Board: 2021 (bar) compared to 2020 (square)



Statistically significant decrease in NHS Ayrshire and Arran, NHS Tayside, NHS Grampian, Scotland, NHS Greater Glasgow and Clyde, NHS Forth Valley, NHS Lanarkshire, NHS Borders and NHS Highland.

Statistically significant increase in NHS Lothian (but remaining below the Scotland average).

SAS

SAS is a fundamental part of the response to acute stroke in Scotland. SAS is essential to the timely delivery of revascularisation therapy to patients with stroke by correctly identifying stroke in the community and rapidly transporting patients with suspected stroke for assessment in hospital.

The chain of survival for stroke is a model representing the sequence of events which must occur swiftly and effectively for stroke patients to have the best chance of neurological recovery (**Rudd 2020**) (Figure 8).

1. Ambulance control centre (ACC) receives a 999 call.
2. Identify a likely stroke.
3. Mobilise an appropriate ambulance.
4. On-scene interventions of the ambulance clinician.
5. Pre-alert by the ambulance crew to the receiving emergency department.
6. In-hospital stroke pathway activated.

Here we focus on the pre-hospital component of the stroke chain-of-survival highlighting the links which are the focus of optimisation work by SAS.

Figure 8: Chain of survival for stroke modified from Rudd et al 2020

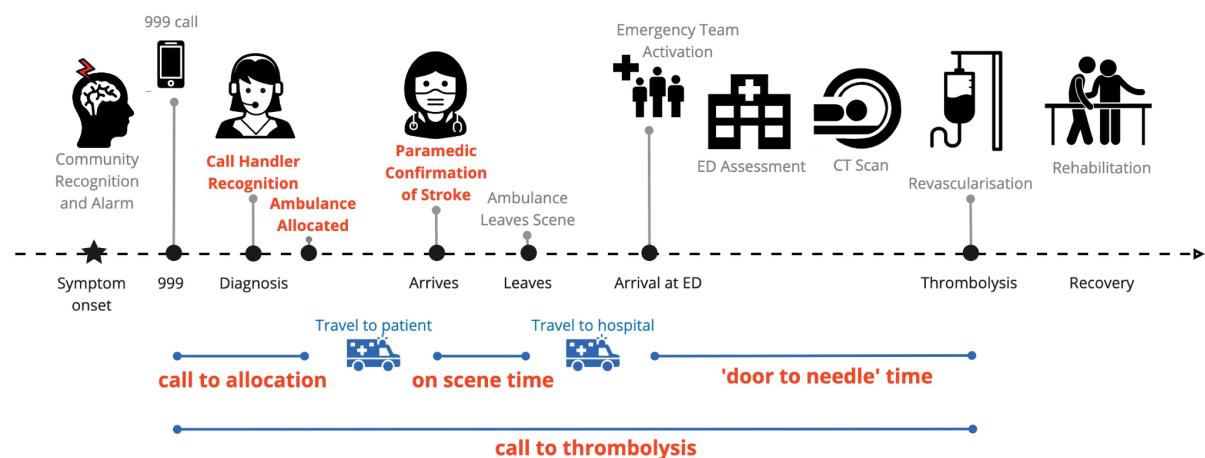


Table 1: Incidents triaged as stroke at ACC January–December 2021

Health Board	Absolute volume	Volume per 100,000 population
Ayrshire & Arran	2132	577
Borders	606	525
Dumfries & Galloway	881	592
Fife	1965	526
Forth Valley	1486	485
Grampian	2441	417
Greater Glasgow & Clyde	5062	428
Highlands	1700	528
Lanarkshire	2924	442
Lothian	3522	388
Orkney	61	274
Shetland	53	231
Tayside	2113	506
Western Isles	121	453

Figure 9: Volume of incidents triaged as stroke at ACC by calendar year

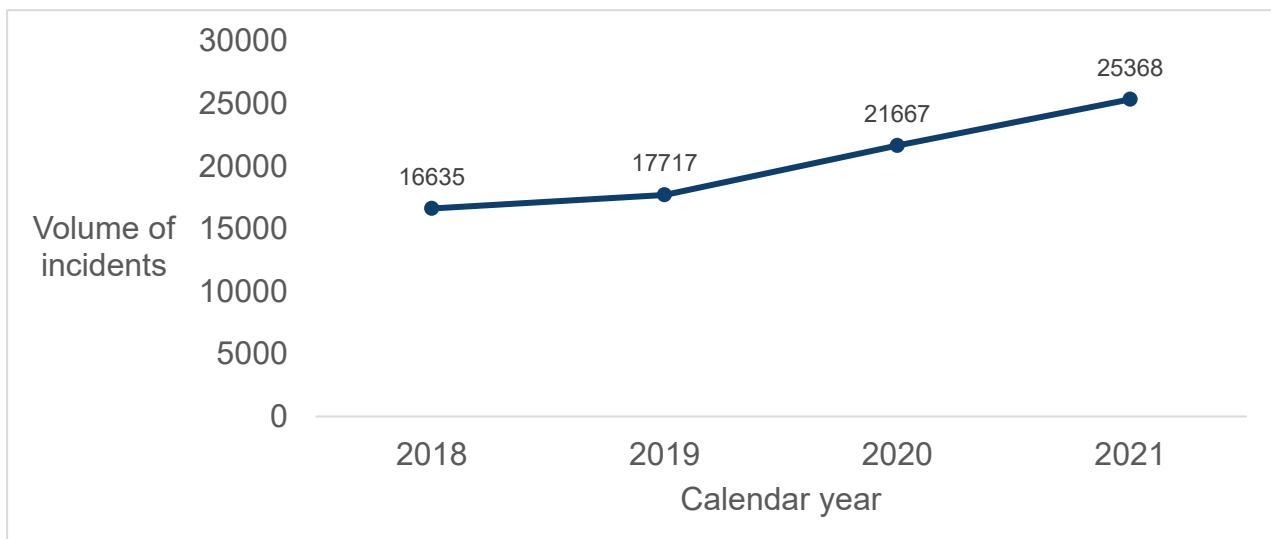


Figure 10: Volume of incidents triaged as stroke at ACC each calendar year

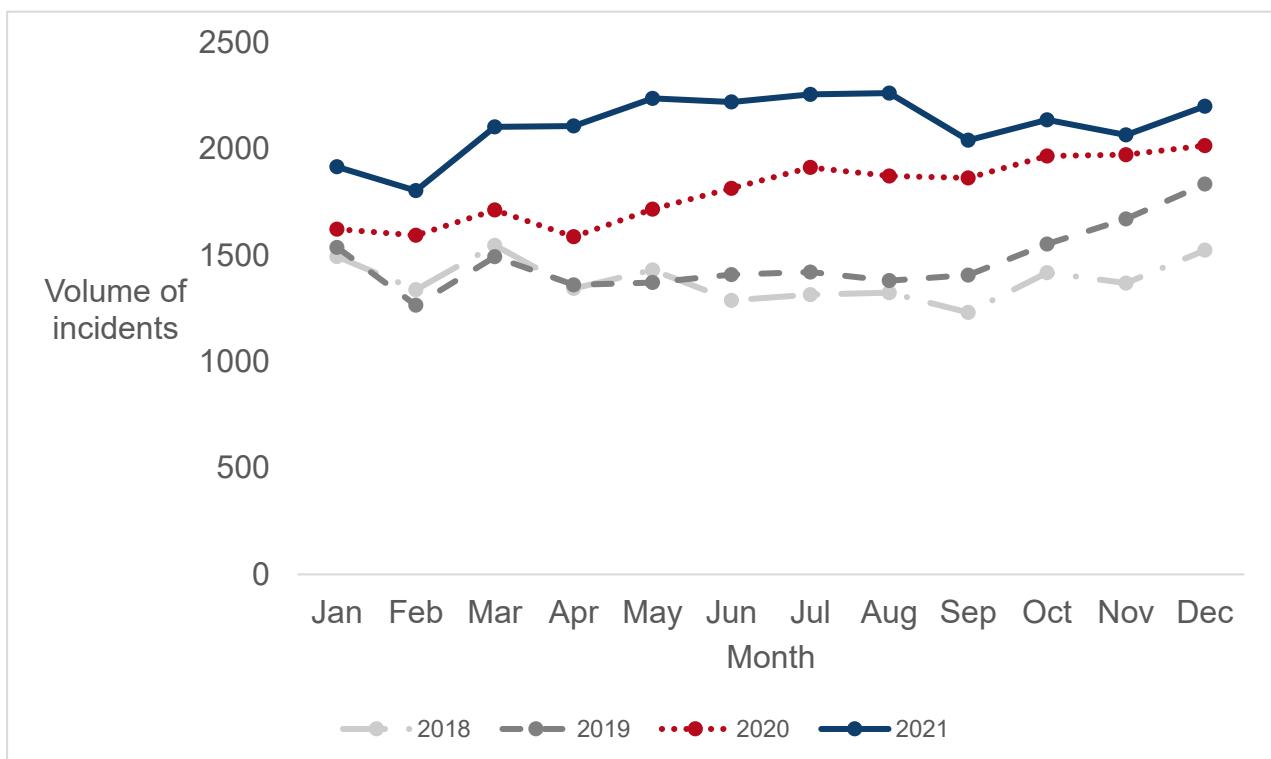


Table 2: Matrix of incident day and hour for amber priority and above January–December 2021

Day of week	0000–0359	0400–0759	0800–1159	1200–1559	1600–1959	2000–2359
Monday	154	244	757	692	594	397
Tuesday	184	204	755	728	602	413
Wednesday	147	252	742	699	563	393
Thursday	147	186	788	701	561	349
Friday	152	202	758	689	597	394
Saturday	168	191	692	726	586	416
Sunday	218	211	636	677	607	384
Total	1170	1490	5128	4912	4110	2746

Table 3: Matrix of incident day and hour for yellow priority and below January–December 2021

Day of week	0000–0359	0400–0759	0800–1159	1200–1559	1600–1959	2000–2359
Monday	20	68	322	229	179	66
Tuesday	29	80	247	222	173	93
Wednesday	38	62	286	211	153	91
Thursday	33	66	290	227	146	102
Friday	32	71	292	222	155	95
Saturday	45	51	236	171	142	93
Sunday	27	61	225	246	137	78
Total	224	459	1898	1528	1085	618

Figure 11: Volume of incidents by hour of day for amber priority and above January–December 2021

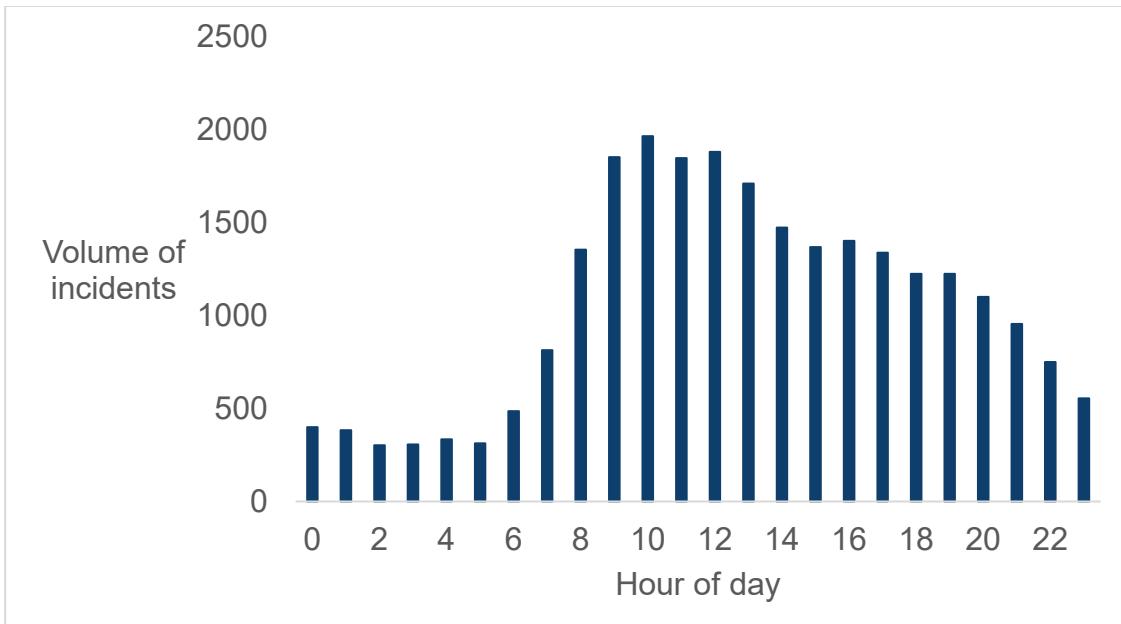
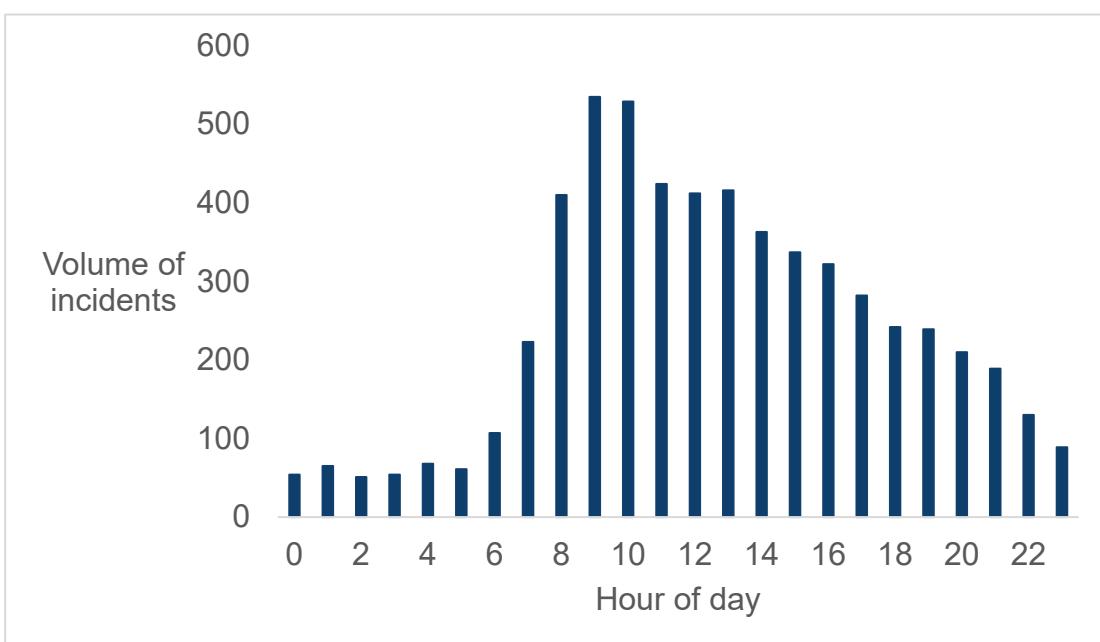


Figure 12: Volume of incidents by hour of day for yellow priority and below January–December 2021



Time to thrombolysis

Time to thrombolysis is a critical determinant of favourable outcomes in acute ischaemic stroke. This measure is the overall time taken from receipt of the 999 call by SAS to the subsequent delivery of an intravenous thrombolytic agent in hospital. It is therefore a benchmark for the whole system of stroke care delivery.

Table 4 shows the mean time from receipt of 999 call to delivery of in-hospital thrombolysis in each Health Board in Scotland.

Figure 13 shows the mean time to thrombolysis plotted against the number of incidents. The dotted lines show control limits at 2 standard deviations (SDs) from the mean. Points outside of the dotted lines show unexpected variation from the national mean.

Figure 14 shows the trend in the national mean time to thrombolysis over the three years from January 2019 to December 2021.

Table 4: Mean time from incident start to start of thrombolysis treatment January-December 2021

Health Board	Number of Cases	Mean time to treatment (minutes)
Ayrshire & Arran	70	186
Borders	20	144
Dumfries & Galloway	26	131
Fife	84	116
Forth Valley	41	196
Grampian	136	128
Greater Glasgow & Clyde	174	132
Highlands	53	151

Health Board	Number of Cases	Mean time to treatment (minutes)
Lanarkshire	90	125
Lothian	136	125
Tayside	93	122
Islands	10	132

Figure 13: Funnel plot of mean time from incident start to start of thrombolysis treatment, by Health Board January–December 2021

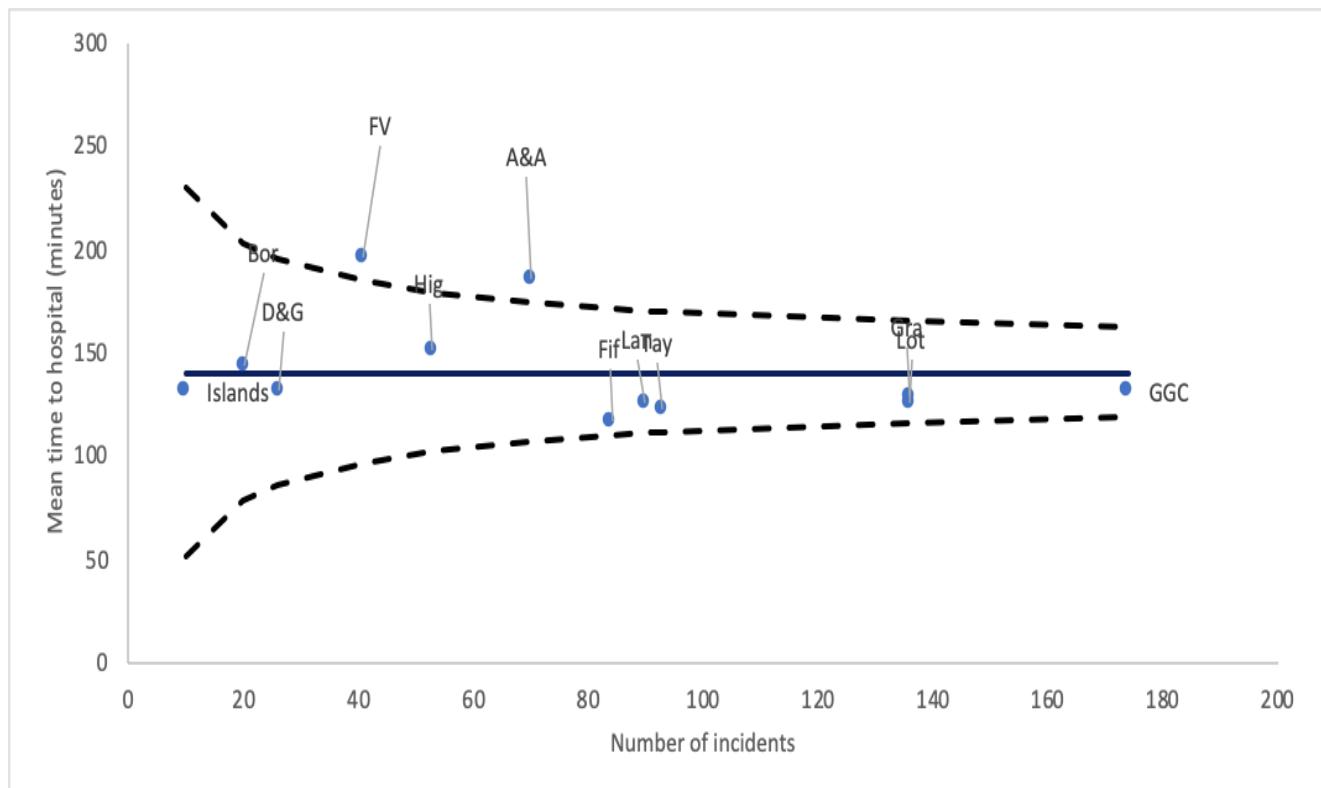
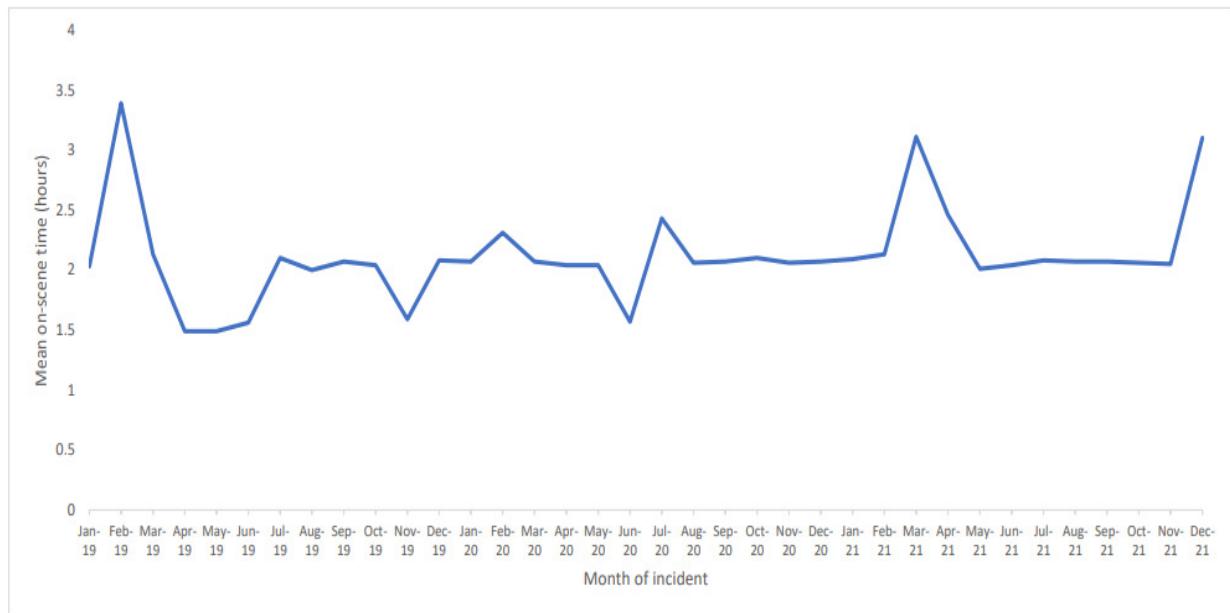


Figure 14: Mean time from incident start to start of thrombolysis treatment January 2019–December 2021



In considering how to minimise the prehospital component of the time to thrombolysis we can look at the elements in the SAS prehospital chain of survival for stroke which contribute to the overall time:

- SAS Call Handler recognition of stroke during initial 999 call
- Allocation and dispatch of an appropriate SAS resource
- Rapid on-scene assessment of the patient by SAS clinicians
- Confirmation of stroke by SAS clinicians
- Transport to hospital, with pre-alerting of the in-hospital team

Time delays could be minimised through the identification of modifiable delays affecting these elements and the implementation of targeted solutions. SAS currently has ongoing quality improvement work in all of these areas.

SAS call handler recognition of stroke, allocation and dispatch of an appropriate SAS resource

All 999 calls to SAS are triaged using the Medical Priority Dispatch System (MPDS). Call handlers take the caller through a series of questions leading to each incident receiving a diagnostic code and call priority (represented by a response colour). Once the call priority has been determined, an appropriate ambulance resource is allocated as soon as possible.

For any call where stroke is mentioned as the chief complaint or other signs or symptoms are mentioned suggesting a stroke, callers are taken through stroke screening and guided through performing a FAST (face, arm, speech test).

If the FAST is positive, and the onset of symptoms is less than 4.5 hours, this indicates a hyper-acute stroke (HAS) and an amber response is generated.

FAST negative patients may also receive an amber response if on further questioning key symptoms (e.g., severe headache and dizziness) are elicited by the call handler and a hyper-acute stroke may be the potential cause.

Where the patient with a suspected stroke has an unknown time of symptom onset (the patient woke up with symptoms or has not been seen by the caller in the previous 5 hours), these incidents are also prioritised as an amber response.

The target ambulance response time for amber priority incidents is 19 minutes. The amber response also means that the resource sent to the patient will be capable of transporting them to hospital – avoiding the situation where a non-conveying response is sent (e.g., a rapid response car) resulting in delay waiting for an ambulance to transport the patient.

Time to allocation is the time measured from the start of the 999 call, to the time at which the initial call handler assessment has been made and an available ambulance resource identified to respond to the stroke patient.

Table 5 shows the mean time from start of incident to allocation of conveying resource by Health Board which is plotted against the number of incidents in the funnel plot in Figure 15.

During 2021, the mean time to allocation across Scotland was 11.02 minutes.

In three Health Board areas, the mean allocation time was outside of the control limits of the funnel plot (set at 2 SD from the mean) suggesting unexpected variation: NHS Ayrshire and Arran; NHS Greater Glasgow and Clyde; and NHS Lanarkshire; with mean times of 17.45 minutes, 21.18 minutes, and 21.47 minutes respectively.

The reasons for longer resource allocation times are complex and include high ambulance service demand and longer hospital turnaround times, creating demand versus capacity mismatch. Figure 16 shows the trend in mean call to allocation time over the last 3 years.

Table 5: Mean time from incident start to allocation of conveying resource for incidents triaged as amber stroke at ACC January–December 2021

Health Board	Number of cases	Mean time to allocation (mins)
Ayrshire & Arran	1,190	17.45
Borders	366	6.19
Dumfries & Galloway	518	7.45
Fife	1,084	10.1
Forth Valley	905	11.11
Grampian	1,224	10.3
Greater Glasgow & Clyde	3,270	21.18
Highlands	925	7.32
Lanarkshire	1,921	21.47
Lothian	2,239	11.58

Health Board	Number of cases	Mean time to allocation (mins)
Orkney	33	8.58
Shetland	31	5.12
Tayside	1,012	9.15
Western Isles	69	7.24

Figure 15: Funnel plot of mean time from incident start to allocation of conveying resource by Health Board for incidents triaged as amber stroke at ACC January–December 2021

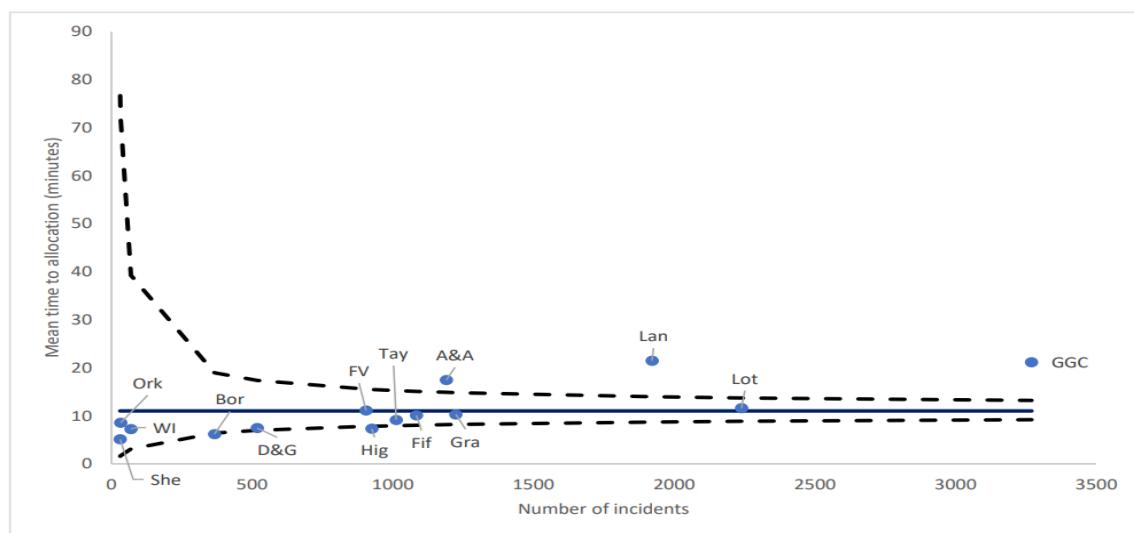
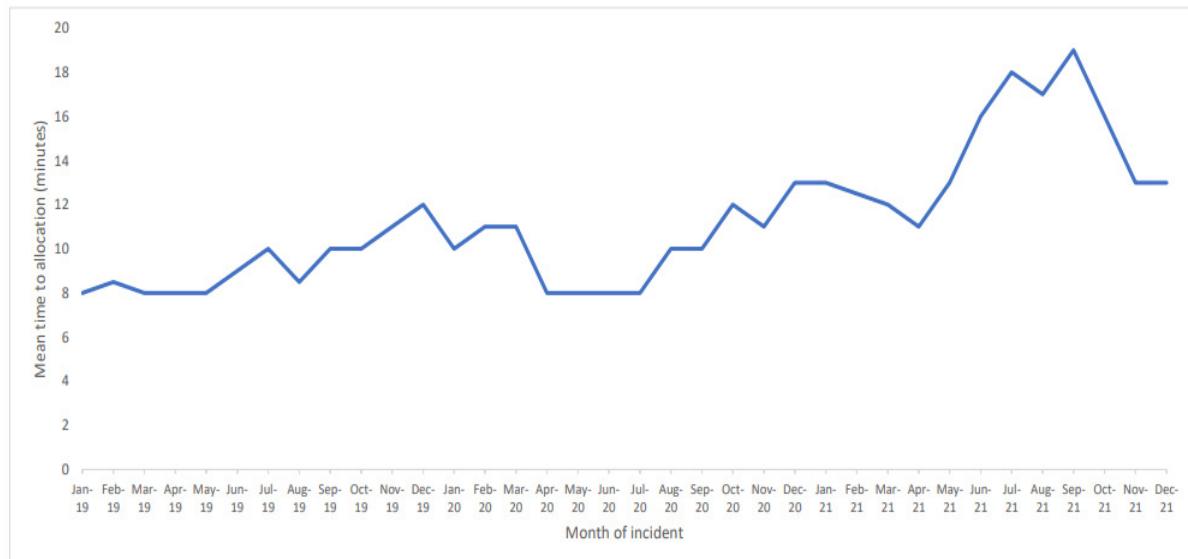


Figure 16: Mean time from incident start to allocation of conveying resource for incidents triaged as amber stroke at ACC January 2019–December 2021



Rapid on-scene assessment of the patient

Where on-scene ambulance clinicians suspect onset of stroke symptoms within 4.5 hours or unknown, a pre-hospital clinical pathway is followed.

The pathway requires the ambulance clinicians to take an accurate clinical history of the problem, carry out the FAST and perform a series of physiological observations (blood pressure, heart rate, blood oxygen saturation, body temperature and blood sugar levels). This assessment is designed to confirm the diagnosis of stroke and detect possible stroke mimics or other causes of acute neurological deterioration.

The history taken from the patient or carers will also help determine the timing of the onset of symptoms and whether this is a Hyper Acute Stroke. The patient is then transferred to the ambulance and transported to hospital. In the case of suspected HAS this is done as quickly as possible.

Over the last two years, SAS have witnessed an increase in on-scene times across all conditions. Some of this can be attributed to the requirement to apply appropriate

personal protective equipment (PPE) as a result of the COVID-19 pandemic, though there are likely to be multiple factors involved.

To minimise time-to-hospital for patients suspected of sudden onset of stroke symptoms, a programme of work has been undertaken to reduce on-scene times.

A focus is to reduce the number of unnecessary clinical interventions carried out at scene by the ambulance clinicians, including 12-lead electrocardiographs (ECGs) and intravenous cannulation, which have been shown to be unnecessary in the majority of stroke patients.

To achieve this, a service-wide improvement programme is underway to re-emphasise the importance of limiting time on-scene while balancing this with providing the highest level of appropriate care.

Table 6 shows the mean on scene time for HAS (amber) strokes from Jan 2020 to Dec 2021.

The funnel plot in Figure 17 shows the mean on-scene time plotted against the number of incidents. The dotted lines show control limits at 2 SDs from the mean. Points outside of the dotted ‘funnel’ show unexpected variation.

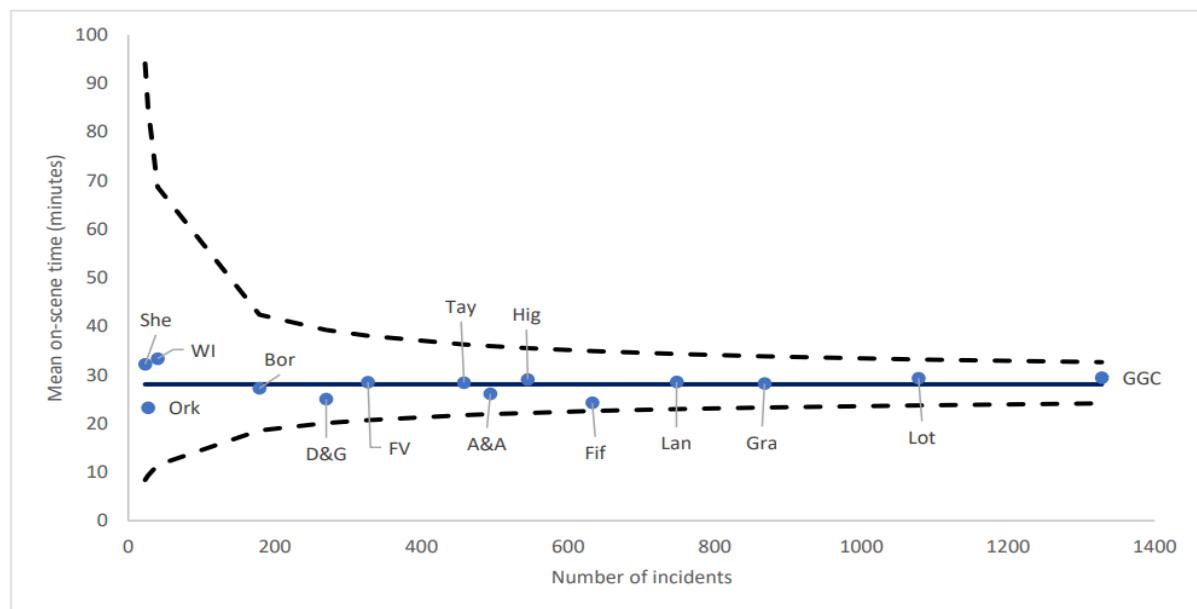
Figure 18 shows the trend in mean on-scene time of conveying resource in patients with HAS from January 2019–December 2021.

Table 6: Mean on-scene time of conveying resource in patients with Hyper Acute Stroke (HAS) Jan-Dec 2021

Health Board	Number of cases	Mean on-scene time (mins)
Ayrshire & Arran	494	26.11
Borders	179	27.23
Dumfries & Galloway	270	25.01
Fife	633	24.26
Forth Valley	327	28.5

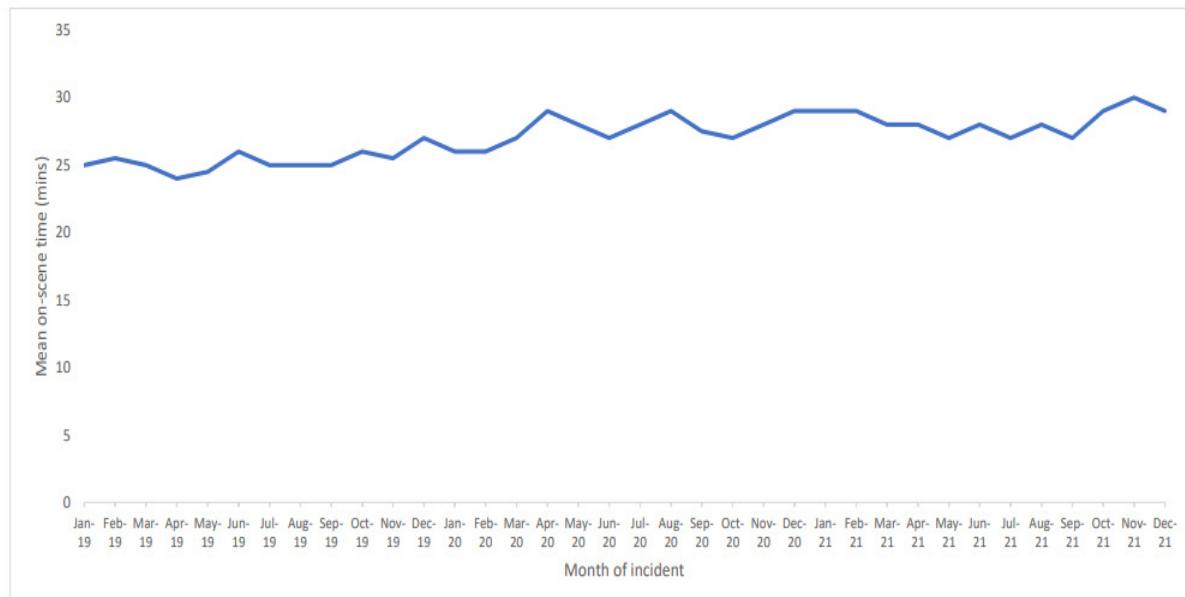
Health Board	Number of cases	Mean on-scene time (mins)
Grampian	868	28.24
Greater Glasgow & Clyde	1,328	29.44
Highlands	545	29.07
Lanarkshire	748	28.55
Lothian	1,078	29.33
Orkney	27	23.24
Shetland	23	32.19
Tayside	458	28.41
Western Isles	40	33.36

Figure 17: Funnel plot showing mean on-scene time of conveying resource in patients with HAS January–December 2021



Key: A&A, Ayrshire and Arran; Bor, Borders; D&G, Dumfries and Galloway; FV, Forth Valley; Fif, Fife; Gra, Grampian; GGC, Greater Glasgow and Clyde; Hig, Highland; Lan, Lanarkshire; Lot, Lothian; Ork, Orkney; She, Shetland; Tay, Tayside; WI, Western Isles.

Figure 18: Mean on-scene time of conveying resource in patients with HAS January 2019–December 2021



Confirmation of stroke by frontline paramedics

SAS clinicians are in a unique position to reduce delays in presentation and treatment in acute stroke.

To make timely decisions about patient management and transport, clinicians at the scene must make an accurate assessment of whether or not the patient suspected of having a stroke does, in fact, have a stroke. To achieve this, rapid assessment is carried out using the approach described above.

Under-diagnosis of stroke (poor sensitivity) could result in delays to effective treatment. Over-diagnosis (poor specificity) might mean unnecessary emergency transport and activation of hospital-based staff, which risks negatively impacting the care of other critically ill patients.

To measure and monitor this, we calculate the sensitivity, specificity and overall accuracy of SAS clinician stroke diagnosis. The assumptions made and the calculations performed are summarised online.

The funnel plot in Figures 19, 20 and 21 show the sensitivity, specificity and accuracy of stroke diagnosis by SAS clinicians compared to the gold standard of 'final diagnosis' in the SSCA (after in-hospital assessment, neuroimaging and specialist care).

The mean figures for each Health Board are shown in addition to the national mean (grey line). The upper and lower control limits (yellow lines) show 2 SD from the mean.

It is interesting to note that while there are some Health Boards where diagnostic sensitivity or specificity stroke appears higher than expected, most are near the national average for overall accuracy.

Figure 22 shows a plot of sensitivity vs specificity for all Health Boards making it easy to see that while NHS Greater Glasgow and Clyde and NHS Ayrshire and Arran have very similar overall accuracy of diagnosis (72% v. 73%) their patterns of sensitivity and specificity are different in relation to the national average.

Figure 19: Funnel plot showing diagnostic sensitivity of SAS clinicians' determination of stroke compared to SSCA final diagnosis, by Health Board for January–December 2021

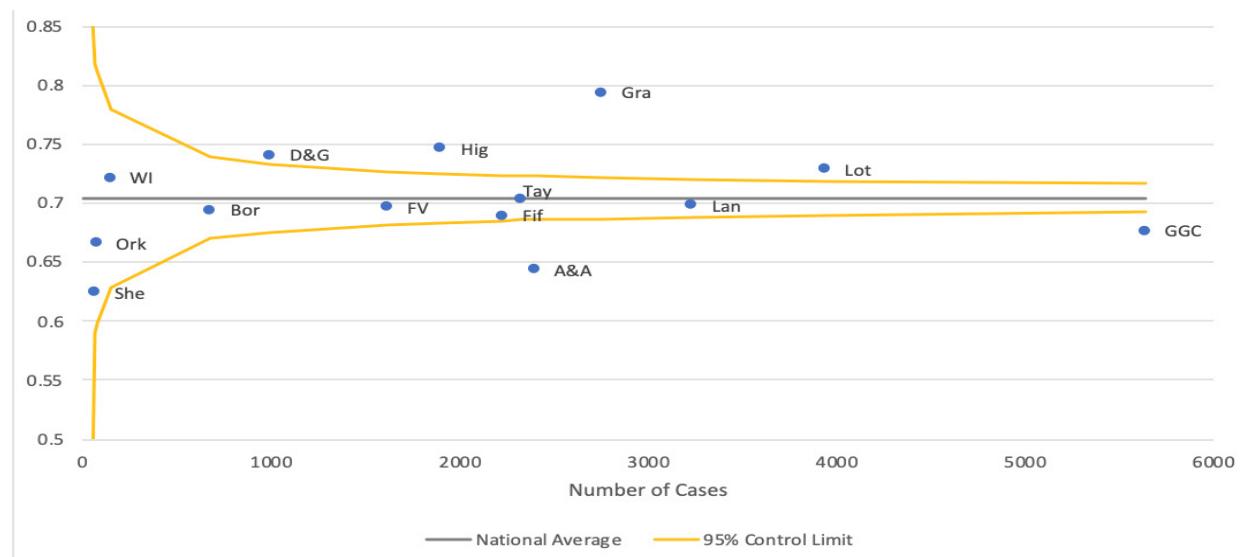


Figure 20: Funnel plot showing diagnostic specificity of SAS clinicians' determination of stroke compared to SSCA final diagnosis, by Health Board for January–December 2021

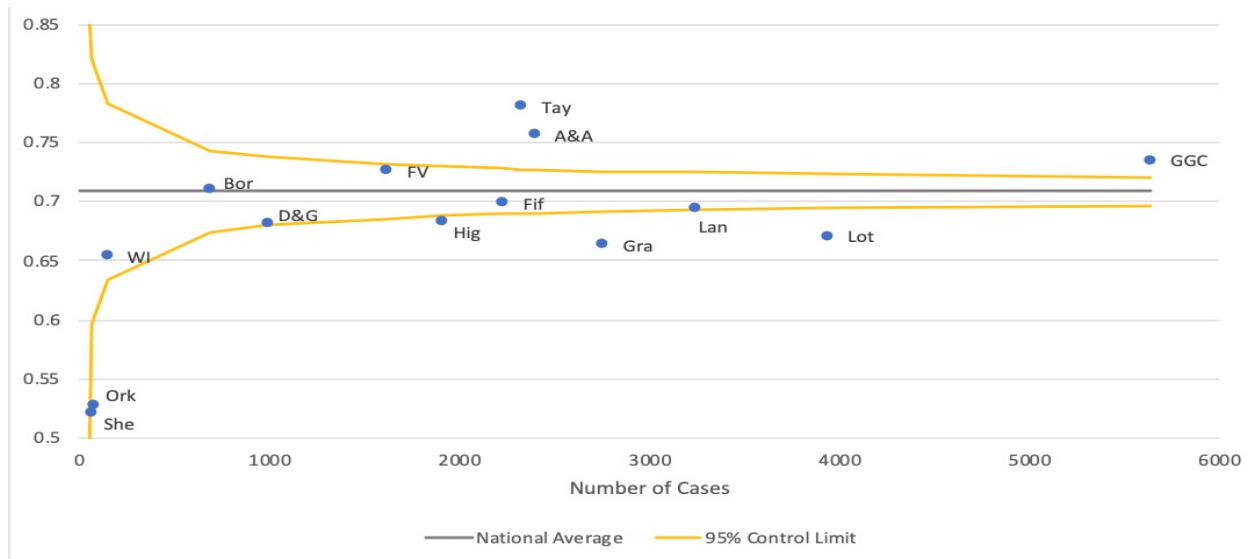


Figure 21: Funnel plot showing diagnostic accuracy of SAS clinicians' determination of stroke compared to SSCA final diagnosis, by Health Board for January–December 2021

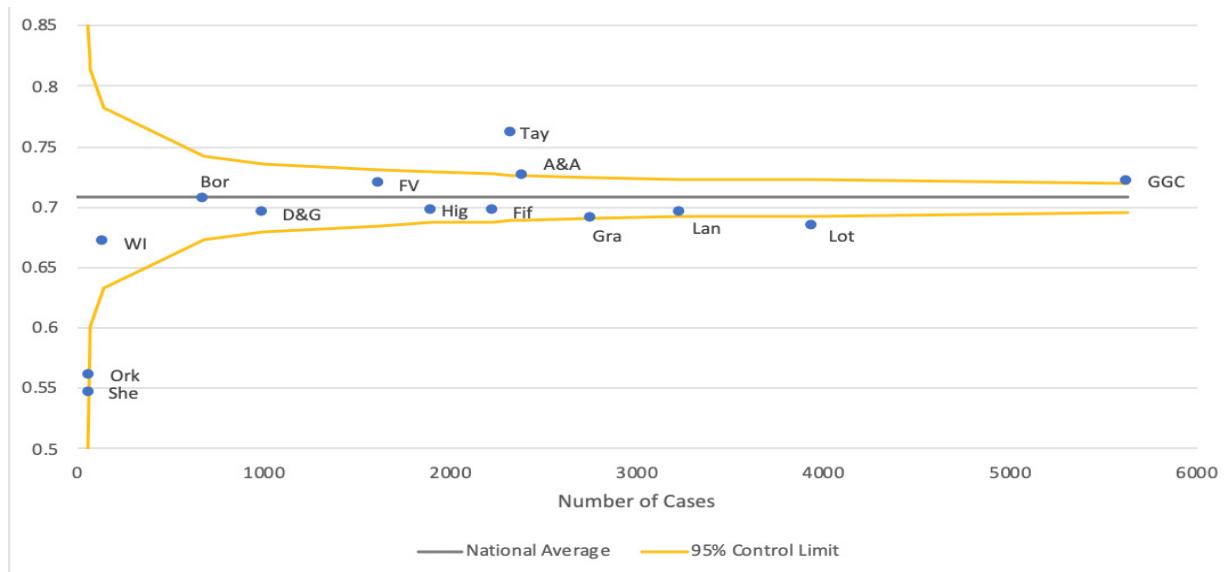
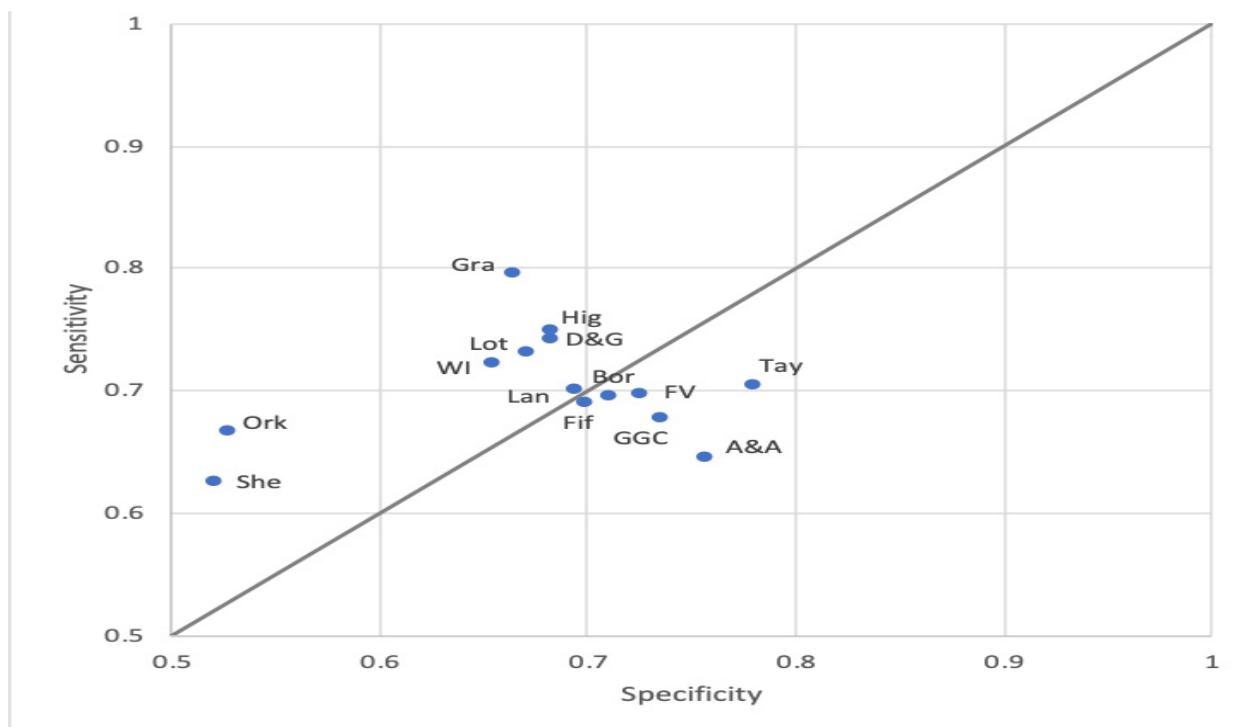


Figure 22: Plot shows diagnostic sensitivity v. specificity of SAS clinicians' determination of stroke compared to SSCA final diagnosis, by Health Board for January–December 2021



Conclusion

SAS is critical to the delivery of a progressive stroke service in Scotland.

Through continued focus on optimising the prehospital links in the chain of survival for stroke we will continue to deliver the foundation for optimal acute stroke care.

Disaggregating data by chain of survival for stroke and geographical analysis is allowing SAS to develop action points within ambulance control and frontline operational scenarios.

The initial exercise to understand the variation is under way and a number of actions to bolster SAS staffing and match resourcing to demand have progressed significantly in the last 18 months.

Where variation is unwarranted, further detailed analysis will be carried out and action points agreed, where necessary, with local Board systems.

Issues that impact generic SAS response also have an impact on stroke response. Among these the most significant current constraint is the situation across Scotland of ambulances queuing outside emergency departments, often for hours at a time, waiting to offload patients. This makes it all the more important that pre-alert and prioritisation of the stroke pathway works effectively against the backdrop of a wider system operating under significant pressure.

The observed link between indicators of multiple deprivation and stroke presentations provides further evidence to SAS that we must be thoughtful about our understanding of the wider needs of the communities we serve and tailor our response accordingly.

Inpatients

The SSCA standards have, for several years, included the proportion of patients with a final diagnosis of stroke who were managed in accordance with all four standards in the care bundle. These care bundle items comprise the prompt delivery of:

- admission to a stroke unit
- brain scanning
- screening for swallow problems
- administering aspirin (unless contraindicated).

Previous research has shown that these items are associated with improved patient outcomes, particularly **admission to a stroke unit**.

Stroke service model

The most common stroke service model was to have acute stroke unit beds in the larger (acute) hospital sites with offsite stroke rehabilitation units for ongoing care. Acute beds were most commonly in an integrated stroke unit (combined acute and rehabilitation) with acute and hyperacute units being less common.

Feedback from sites indicated that during 2021, the normal pattern of stroke unit service continued to be disrupted by the COVID-19 pandemic. The reported causes included staff absences, as well as stroke beds being used for other acute admissions or not being available for infection control reasons.

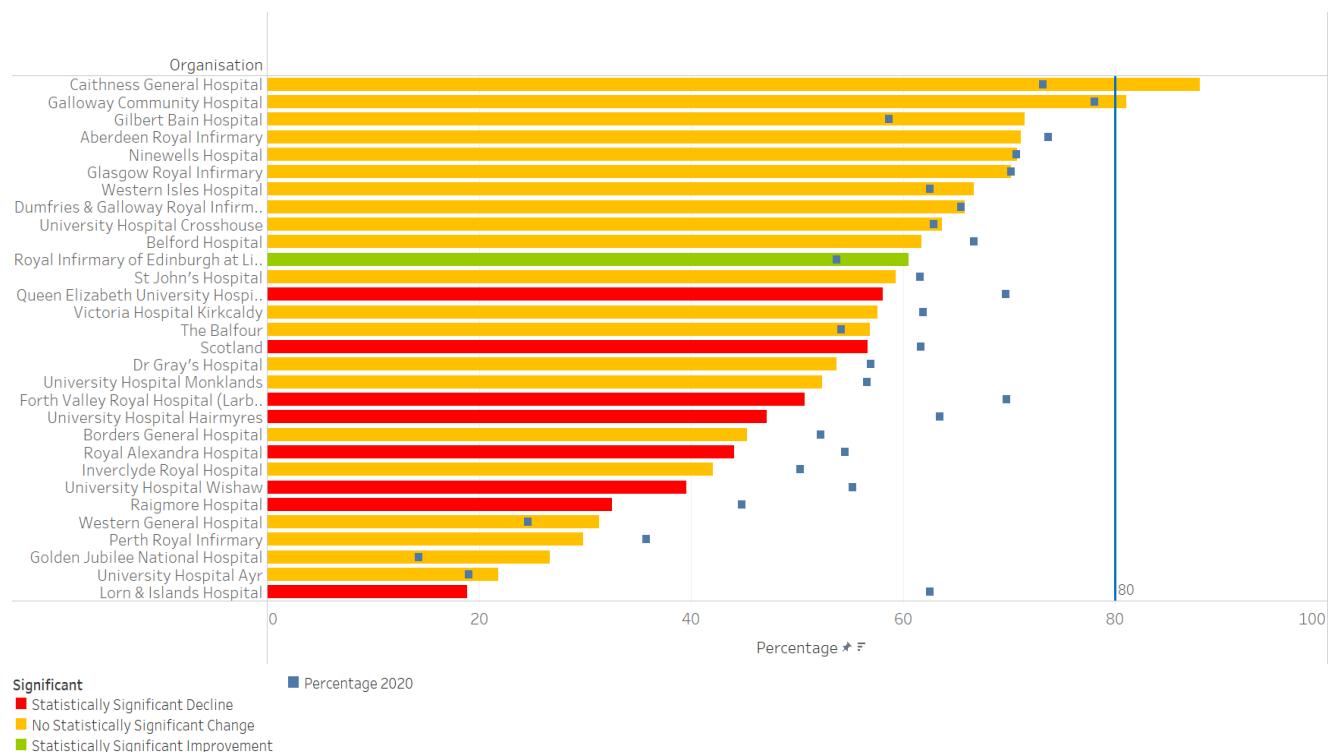
The seven smallest general hospitals define stroke unit admission as 'gaining access to the appropriate acute medical ward'. This definition allowed for a more flexible definition of the patient pathway and appeared to provide an easier achievement of the 'stroke unit admission' standard.

Please note that two hospitals, University Hospital Ayr and National Waiting times Centre at Golden Jubilee Hospital, do not provide services with a normal stroke pathway. Therefore, they are frequent outliers in the figures.

Achieved all four standards

The proportion of patients across Scotland with a final diagnosis of stroke who achieved all four standards of the bundle declined during 2021 compared with 2020 (57% v. 62%) (Figure 23). This pattern was seen across the country with only a few small hospitals matching their achievements for 2020.

Figure 23: Stroke patients receiving the appropriate stroke bundle by site: 2021 (bar) compared to 2020 (square)



Statistically significant decrease at Queen Elizabeth University Hospital, Scotland, Forth Valley Royal Hospital, University Hospital Hairmyres, Royal Alexandra Hospital, University Hospital Wishaw, Raigmore Hospital, and Lorn and Islands Hospital.

Statistically significant increase at Royal Infirmary of Edinburgh.

Admission to a stroke unit within 1 day

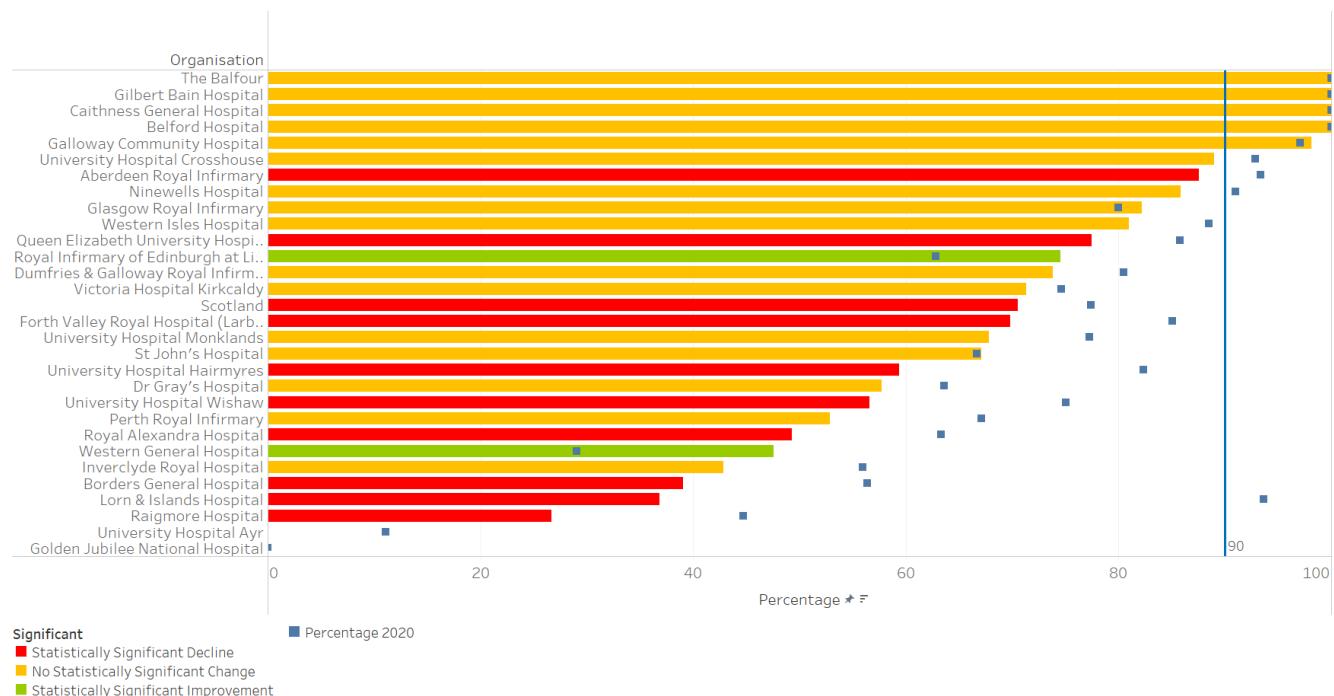
The proportion of patients across Scotland with a final diagnosis of stroke who accessed a stroke unit on the day of admission or the day after dropped to 71% in 2021 (from 77% in 2020) (Figure 24).

A closer examination of the results indicates that this drop in standard was seen predominantly in larger city centre or general hospitals, many of which had reported a disruption in the normal stroke-specific patient pathway because of boarding of patients during the COVID-19 pandemic.

Five small hospitals (Balfour, Gilbert Bain, Caithness General, Belford, Galloway General Hospitals) which define stroke unit admission as 'entering the appropriate acute medical ward' achieved the 90% standard. While some large hospitals did achieve an 80% level of admission the majority fell considerably short of the standard.

The drop in the stroke unit standard suggests a continuing vulnerability of specialist stroke services to urgent external pressures.

Figure 24: Stroke patients being admitted to a stroke unit within 1 day by site: 2021 (bar) compared to 2020 (square)



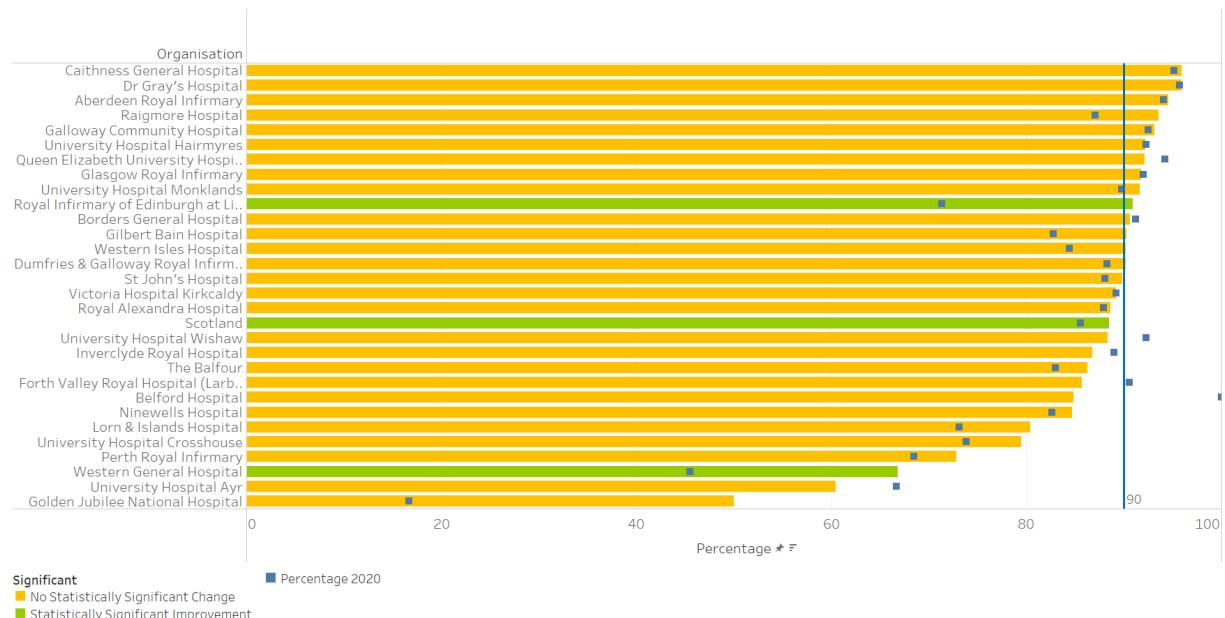
Statistically significant decrease in Aberdeen Royal Infirmary, Queen Elizabeth University Hospital, Scotland, Forth Valley Royal Hospital, University Hospital Hairmyres, University Hospital Wishaw, Royal Alexandra Hospital, Borders General Hospital, Lorn and Islands Hospital, and Raigmore Hospital.

Statistically significant increase in Royal Infirmary of Edinburgh, and the Western General Hospital.

Brain imaging

The brain imaging standard showed a modest improvement across the whole of Scotland (89% in 2021 v. 86% in 2020) (Figure 25). A substantial number of small and larger hospitals attained this standard, and few fell well short.

Figure 25: Stroke patients (%) receiving brain imaging within 12 hours by site: 2021 (bar) compared to 2020 (square)

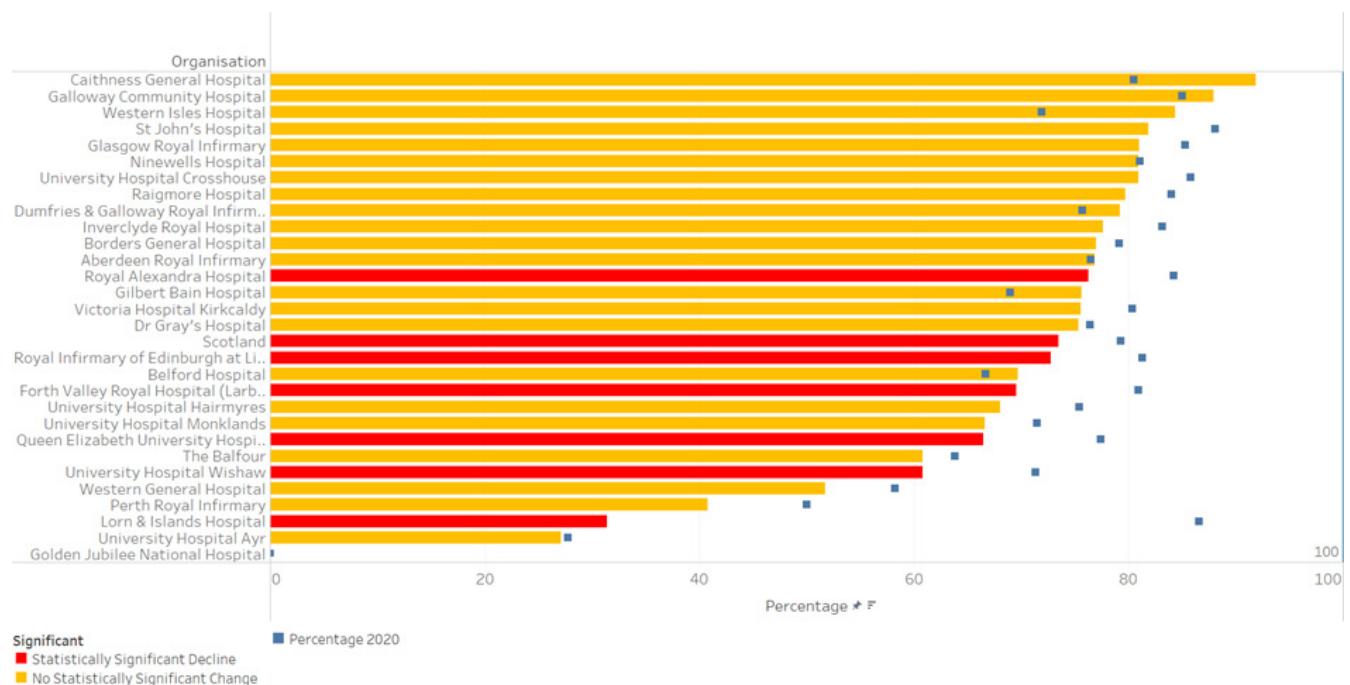


Statistically significant increase in Royal Infirmary of Edinburgh, Scotland and Western General Hospital.

Swallow screening

Across the whole country, the swallow screening performance declined, with 73% meeting the standard (compared to 79% in 2020) (Figure 26). This appeared to be the most challenging of the four bundle components and no individual hospital met this standard.

Figure 26: Stroke patients receiving swallow screen within 4 hours by site: 2021 (bar) compared to 2020 (square)

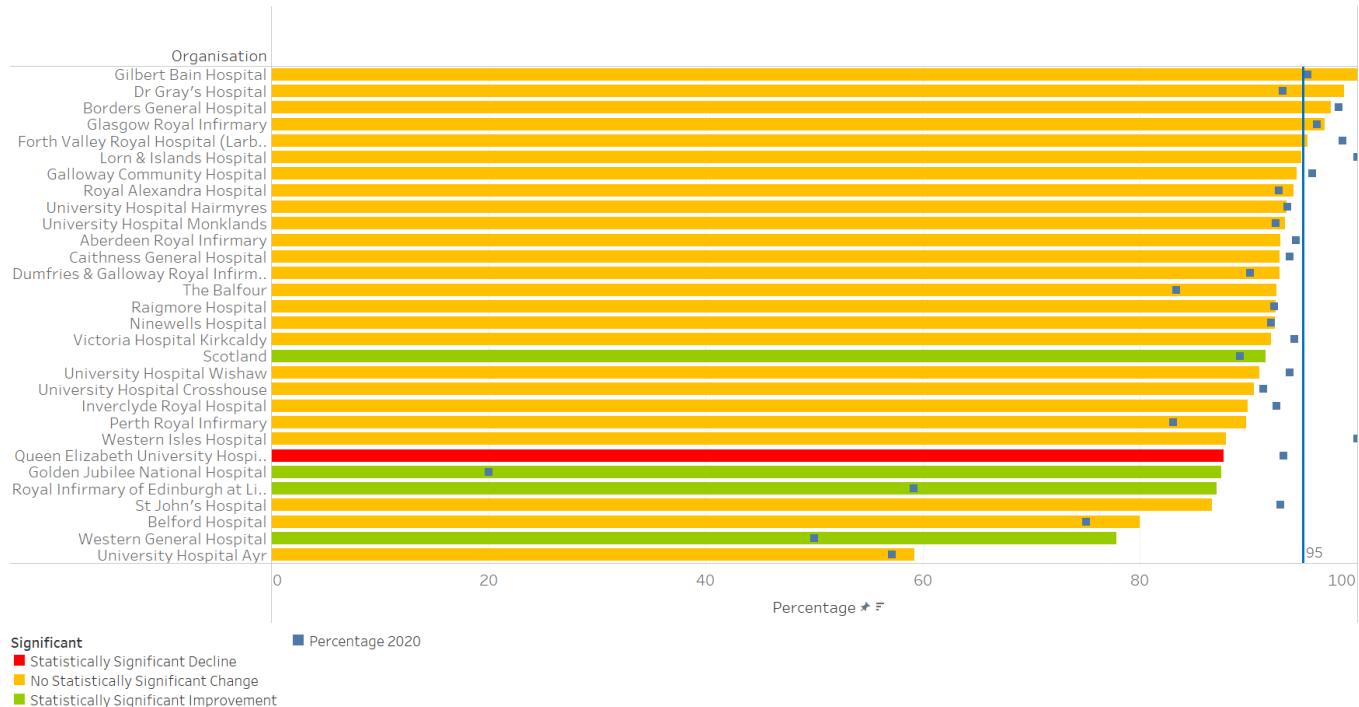


Statistically significant decrease in Royal Alexandra Hospital, Scotland, Royal Infirmary of Edinburgh, Forth Valley Royal Hospital, Queen Elizabeth University Hospital, University Hospital Wishaw, and Lorn and Islands Hospital.

Aspirin therapy

Initiation of aspirin therapy showed a modest improvement (92% in 2021 v. 89% in 2020) (Figure 27). Several hospitals achieved this target, and few fell well short.

Figure 27: Stroke patients receiving aspirin within 1 day by site: 2021 (bar) compared to 2020 (square)



Statistically significant decrease in Queen Elizabeth University Hospital

Statistically significant improvement in Scotland, National Waiting Times Centre at the Golden Jubilee National Hospital, Royal Infirmary of Edinburgh and Western General Hospital.

Discussion

In 2020, we noted a reduction in stroke patient admissions and reductions in bundle performance that coincided with the COVID-19 pandemic; however, the picture in 2021 appears to be more complex.

There were periods of variable stroke inpatient admissions in Scotland during 2021 and disruption of some elements of the stroke bundle. Across Scotland, the

performance for the whole bundle declined in 2021 compared with 2020. However, this incorporated a modest improvement in brain imaging and aspirin initiation but declines in swallow screening and stroke unit admission.

The brain imaging and aspirin initiation measures require access to rapid scanning and medical decision-making but are not fully dependent on smooth patient flow and access to multidisciplinary staffing. For this reason, we believe that the changes relating to swallow screening and stroke unit admission are likely to reflect the impact of the ongoing COVID-19 pandemic on patient flow, and availability of stroke unit beds and staffing.

Thrombolysis

There were 9426 recorded ischaemic strokes (85% of all strokes) in 2021.

Treating eligible ischaemic stroke patients with intravenous clot-busting medication, thrombolysis, is more beneficial the earlier it is administered after an ischaemic stroke occurs. The speed with which the treatment starts after a patient arrives at hospital is recorded and is termed the DTN time.

As this intervention is time critical, there are two national standards for DTN time against which each acute hospital and Health Board's performance are recorded by the SSCA. These are:

- more than 50% are treated under 30 minutes (Figure 28)
- more than 80% treated within 60 minutes of arrival at hospital (Figure 29).

Figure 28: Stroke patients receiving thrombolysis within 30 minutes by Health Board: 2021 (bar) compared to 2020 (square)

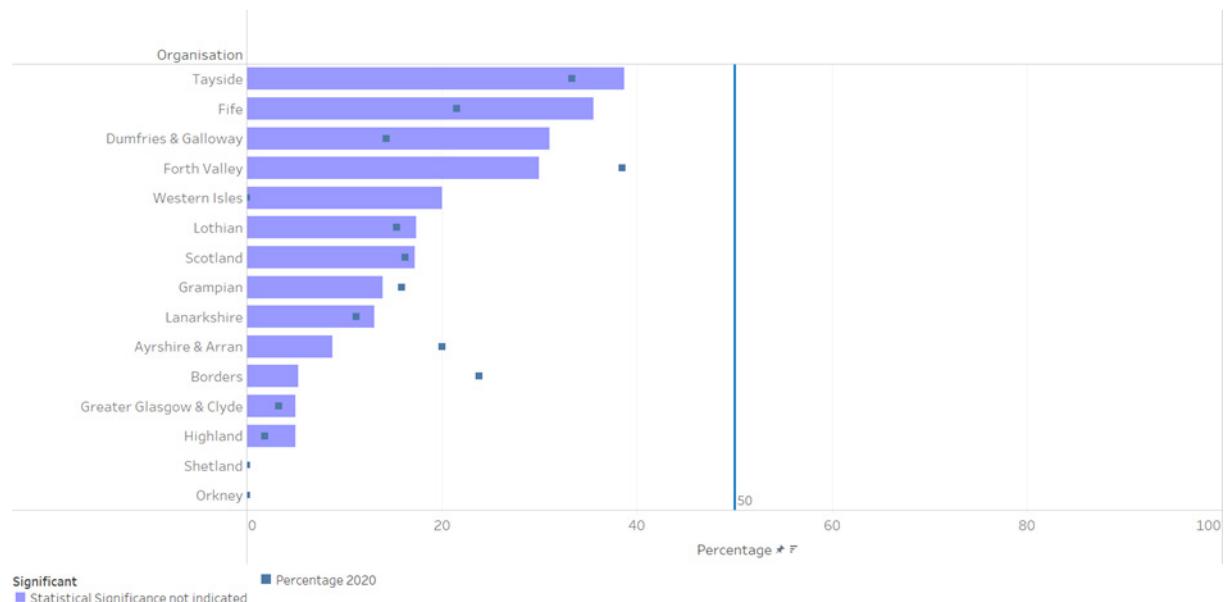
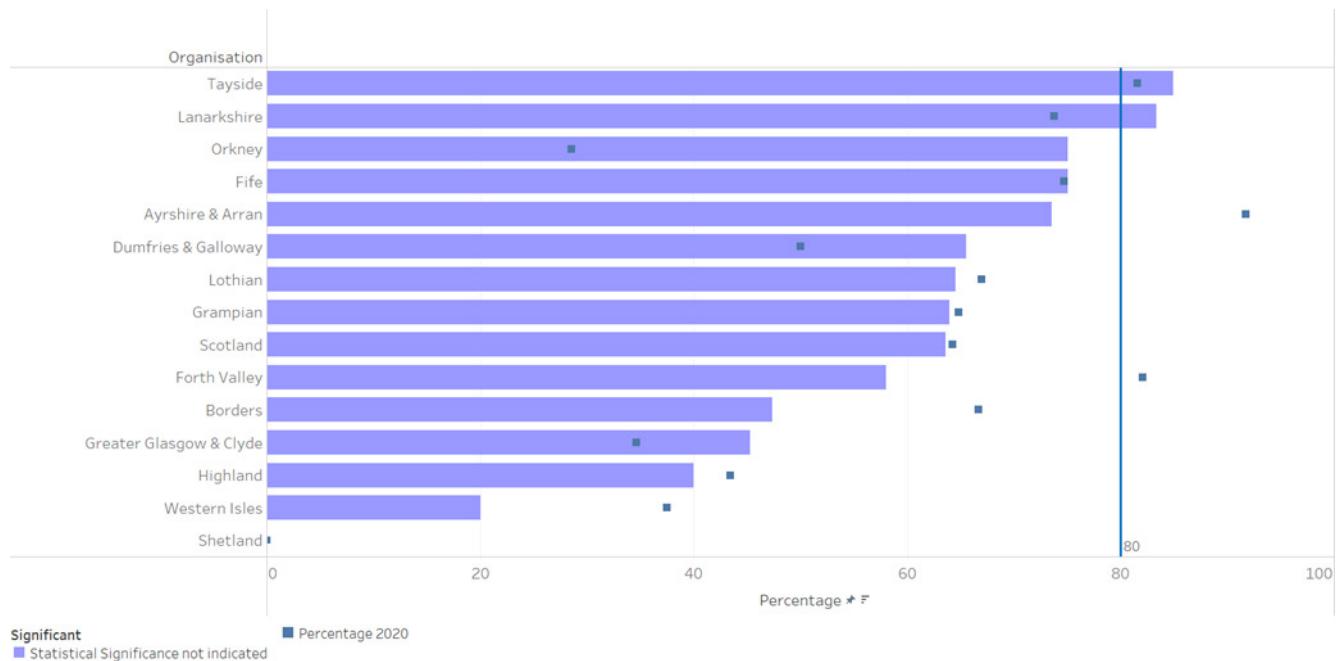


Figure 29: Stroke patients receiving thrombolysis within 60 minutes by Health Board: 2021 (bar) compared to 2020 (square)



Ongoing challenges, secondary to staffing numbers and patient flow considerations during the pandemic, continued to require adaptive working processes and innovative ways of maintaining thrombolysis pathways. Patients required point-of-care COVID-19 testing amidst urgent clinical assessment to help determine places of care and management within appropriately monitored clinical areas.

2021 results compared to 2020

The total number of patients receiving thrombolysis during the 2021 period was 1005 (9.1%) of all stroke admissions, compared to 921 (9.8%) in 2020.

In 2021, the national average (geometric mean) for DTN time was 52 minutes compared to 51 minutes in 2020. The average performance across Scotland has been static for the 30-minute standard. It remained a challenging objective to meet, with none of the Health Boards treating more than 50% of thrombolysis cases within 30 minutes in 2021 (Figure 28).

NHS Tayside continued to perform well and improved overall rates of administering thrombolysis treatment in under 30 minutes (39.4%). Individually, Dumfries and

Galloway Royal Infirmary, and Victoria Hospital Kirkcaldy improved their performance against this standard. Across Scotland, the overall percentage of cases who received thrombolysis in under 30 minutes was 17.2% (16% in 2020 and 2019).

NHS Tayside and NHS Lanarkshire achieved the standard of treating greater than 80% of cases within 60 minutes of arrival at hospital (Figure 29). Nationally, the percentage of cases treated in under 60 minutes was 63.6%. This is unchanged from 2020 (64%).

Figure 30: Numbers receiving thrombolysis (columns) and geometric mean DTN in minutes (line) by months of admission (2019–2021)

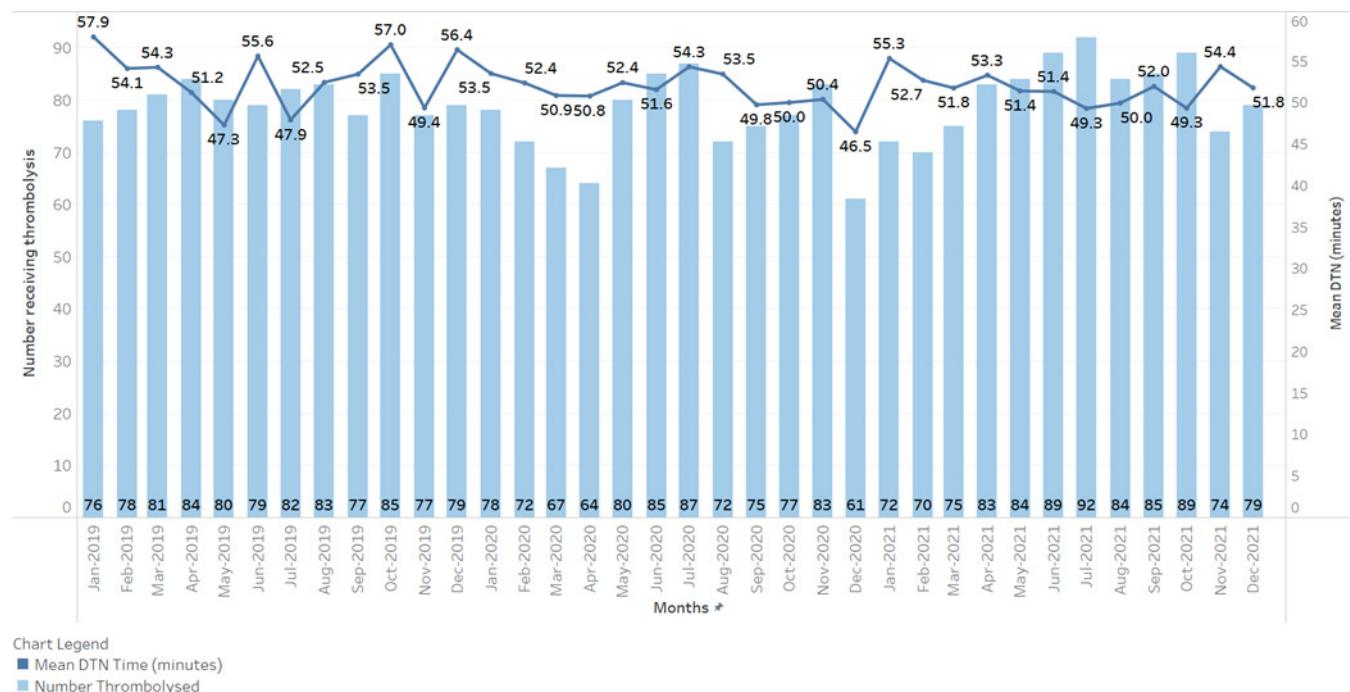
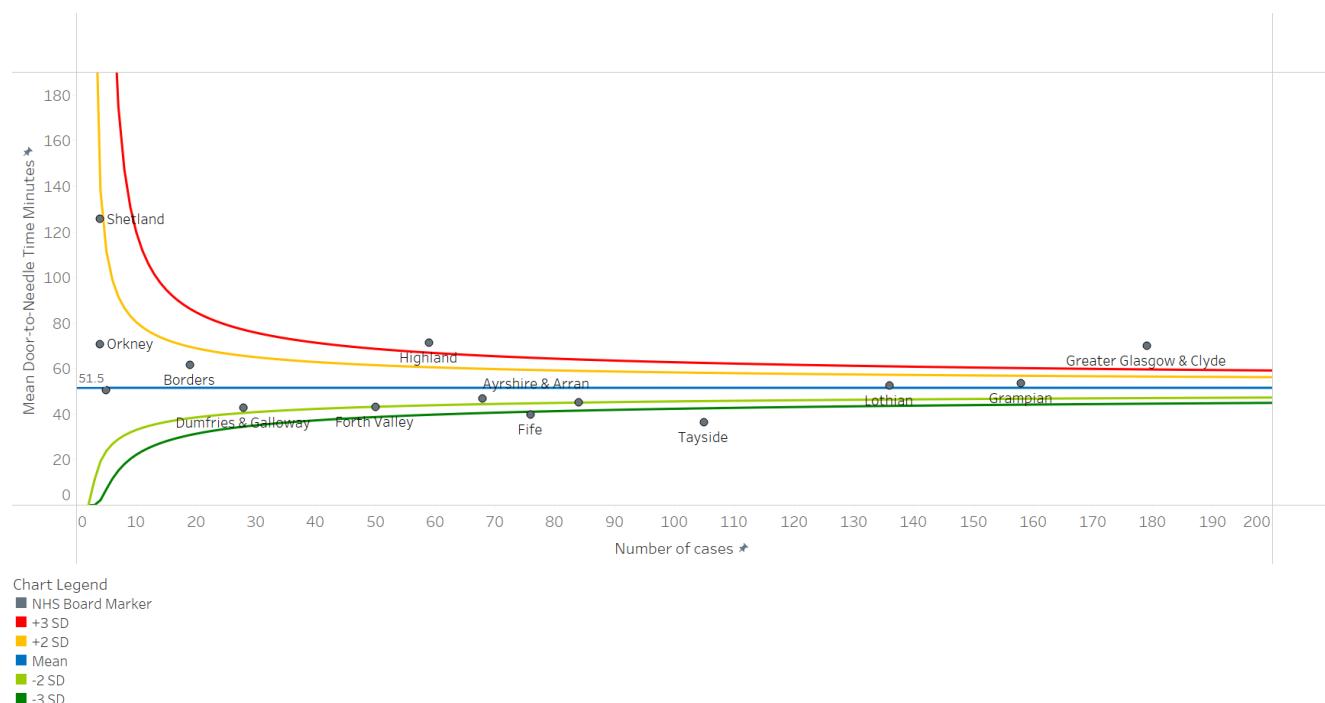


Figure 31: Geometric mean DTN time by first hospital by Health Board: anytime



The rates of thrombolysis within and between Health Boards continued to range widely from 6.4% in NHS Greater Glasgow and Clyde to 18.4% in NHS Grampian. The mean DTN time between Health Boards ranged from 36 minutes (NHS Tayside) to 125 minutes (NHS Shetland) (Figure 31).

Figure 32: Geometric mean DTN time by first hospital by Health Board: Monday to Friday 9am–5pm

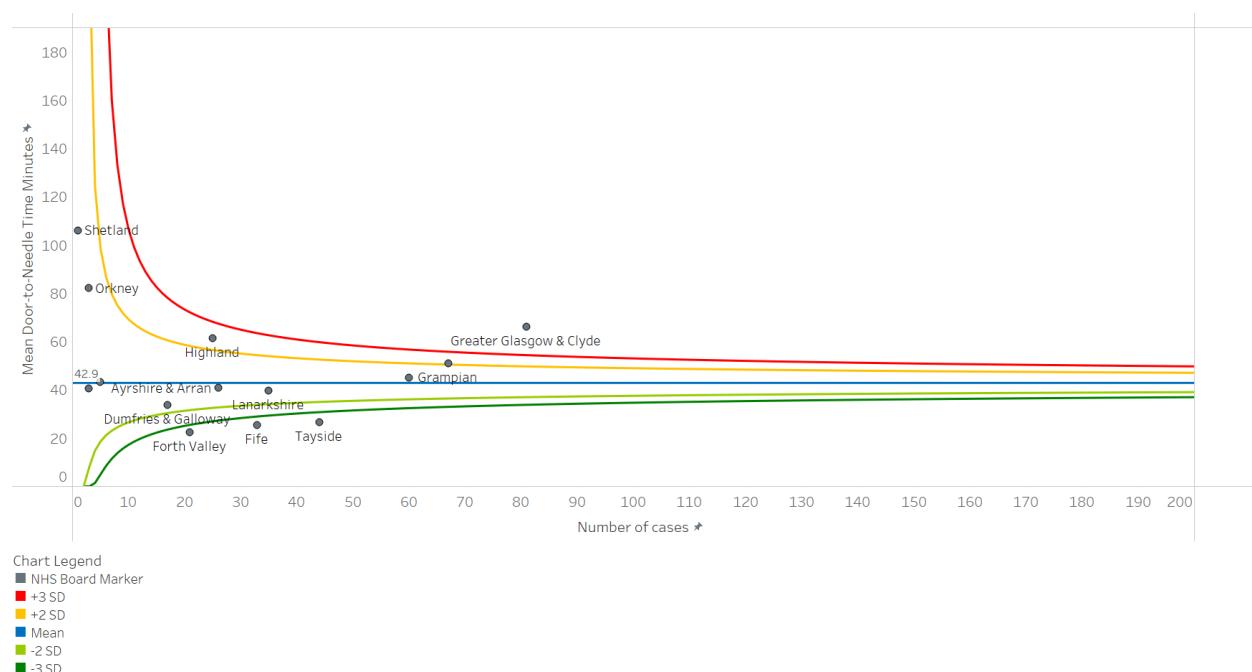
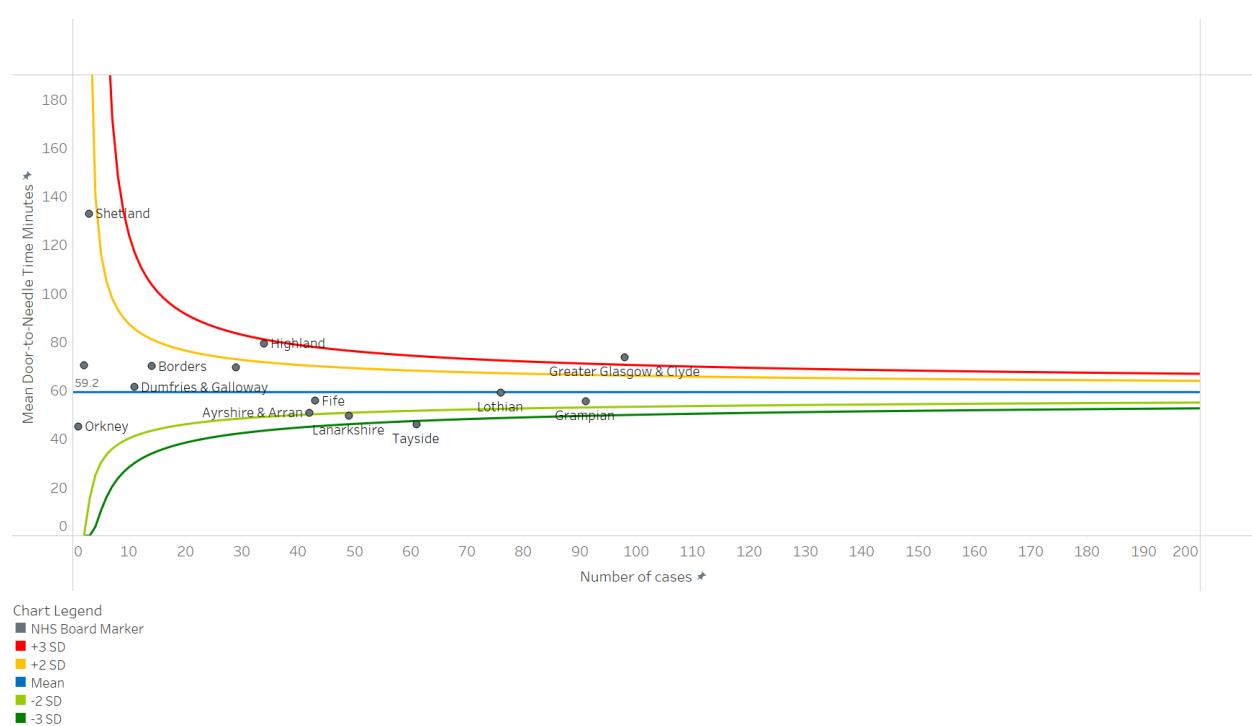


Figure 33: Geometric mean DTN time by first hospital by Health Board: not Monday to Friday 9am–5pm



It is essential that all patients have equitable access to specialist assessment and treatment irrespective of geographical location when their stroke occurs and subsequently when they arrive at a treating hospital.

The geometric mean time 'in hours', i.e. Monday to Friday 9am–5pm, was 43 minutes with a total of 421 (43%) patients treated. Figure 35 shows cases receiving intravenous thrombolysis during these hours.

At other times or 'out-of-hours' the mean DTN was 59 minutes (Figure 33). This is largely unchanged from 2020 (42 minutes and 58 minutes respectively).

Figure 34: Geometric mean DTN time by first hospital: anytime

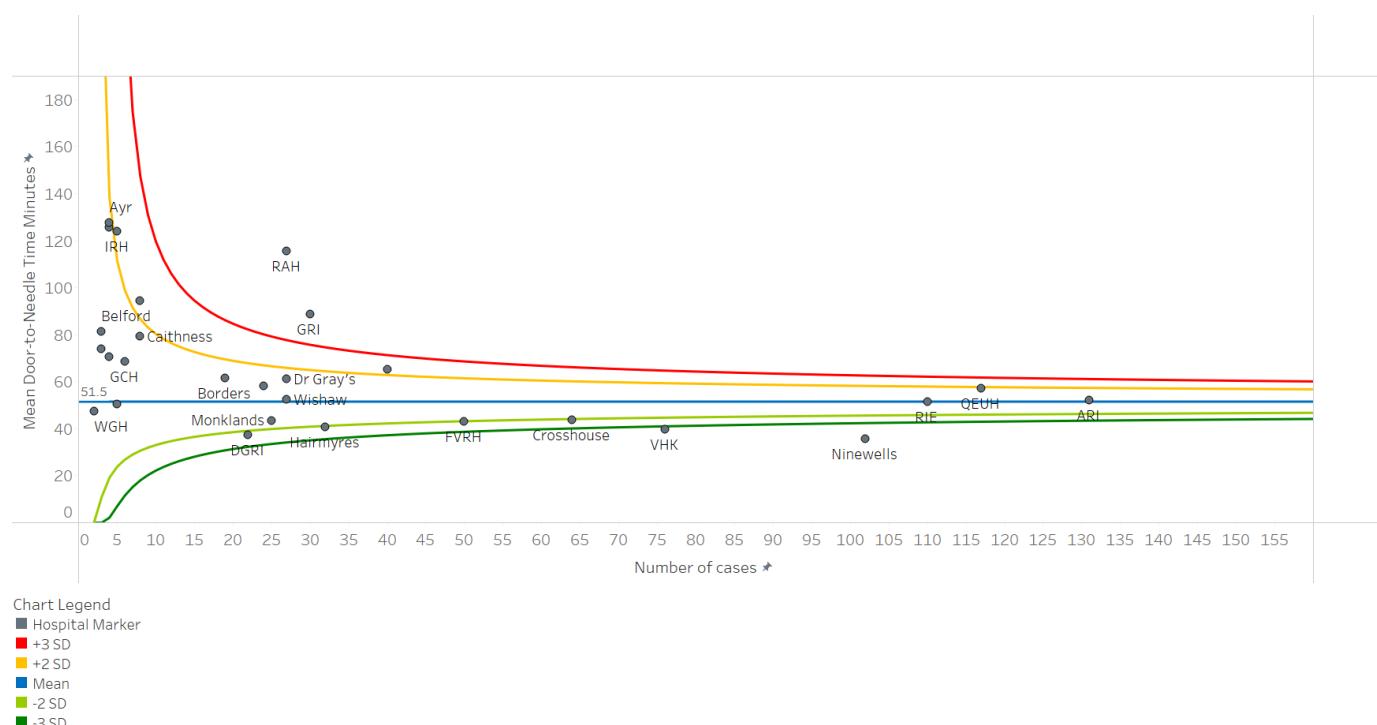


Figure 35: Geometric mean DTN time by first hospital: Monday to Friday 9am–5pm

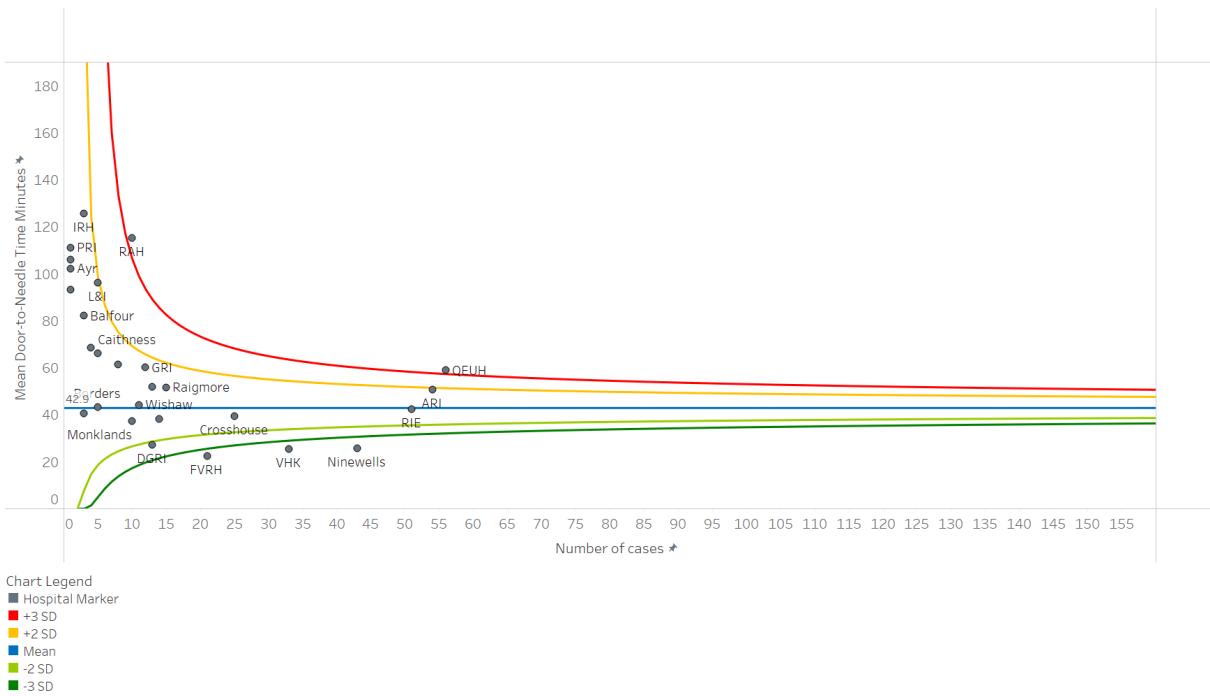
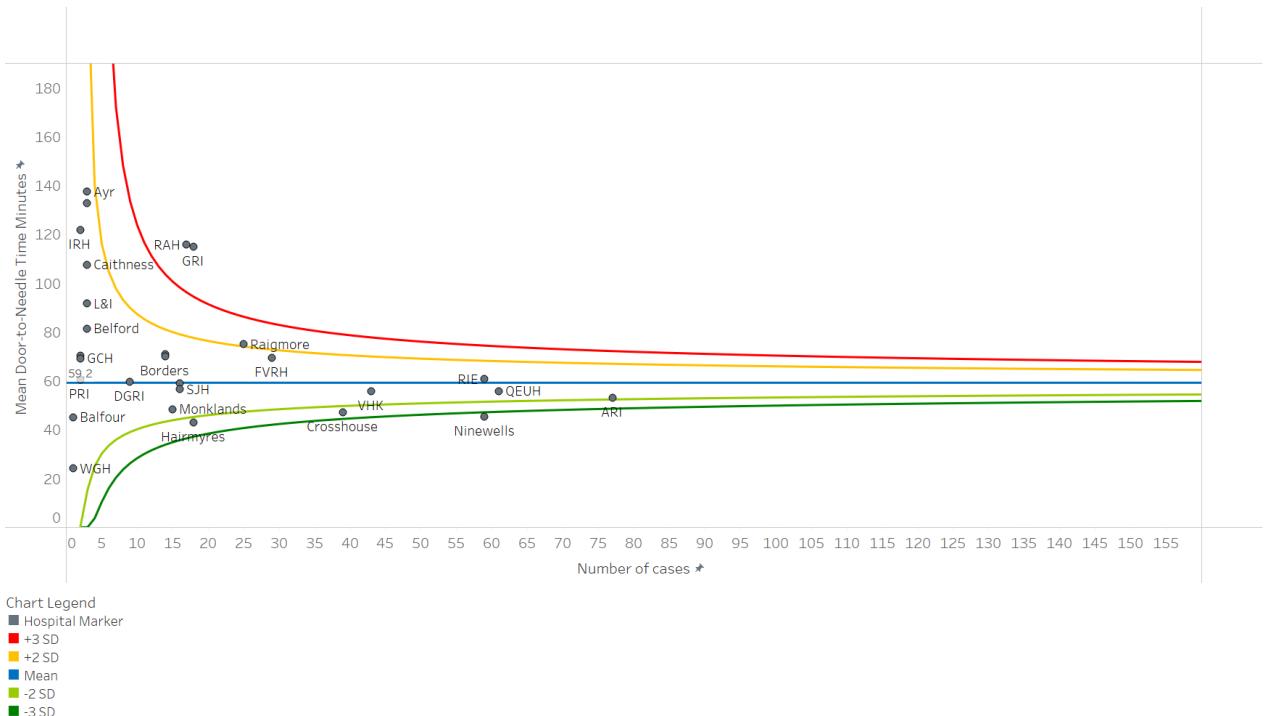


Figure 36: Geometric mean DTN time by first hospital: not Monday to Friday 9am–5pm



Hospitals that performed secondary transfers to another centre for thrombolysis, after initial scanning and in-person assessment, unsurprisingly continued to demonstrate longer DTN times in hours and out-of-hours in 2021. For example, Glasgow Royal Infirmary's mean DTN in hours was 60 minutes 'in hours' and 115 minutes out of hours. Such services are not currently configured to treat and appropriately monitor thrombolysed patients out of hours (Figures 35 and 396).

Service redesign

It is noted that planning work is ongoing within NHS Greater Glasgow and Clyde to develop a telemedicine stroke service aiming to introduce remote specialist assessment of hyperacute stroke patients (telestroke) out-of-hours at Glasgow Royal Infirmary and 24/7 for Royal Alexandra Hospital to improve overall DTN times.

This service redesign will aim to end the practice of transferring patients to Queen Elizabeth University Hospital after initial assessment at the first hospital unless clinically indicated. Similar systems are already embedded within NHS Lanarkshire, Lothian and Grampian, for example, where DTN times in hours and out-of-hours demonstrate less variation.

As some thrombolysis cases will also be potentially suitable for thrombectomy (as they have a large artery blockage), it is essential that the initial assessment and management of the DTN and hyperacute pathway is smooth, efficient and safe at all relevant acute sites.

With approximately 50% of thrombectomy candidates ultimately expected to present to hospital out-of-hours, it is imperative that processes for hyperacute assessment of potential stroke patients are optimised to enable as many eligible cases as possible to receive thrombectomy with minimal delay.

It is hoped that stroke services across Scotland will be enabled to focus on improving pathways and service efficiencies while recovering from the effects of the past 2 years of pandemic-associated disruption. It is recognised that sustainable workforce

numbers and on-call rotas for all staff groups involved are essential to support and sustain meaningful improvements in thrombolysis delivery.

Thrombectomy

Thrombectomy is the physical removal of a thrombus (clot) which is blocking an artery and could cause a stroke. The treatment can significantly increase a person's chance of improving or recovering from an ischaemic stroke if they are clinically suitable for the treatment.

Planned improvements

During 2021, the phased roll out of the provision of thrombectomy continued, supported by the Thrombectomy Advisory Group (TAG) on behalf of the National Planning Board. Once fully implemented over the next few years, it is ultimately expected to carry out about 800 thrombectomies each year across Scotland.

The plan will see the introduction of a hub and spoke model for the delivery of this service with three thrombectomy hubs based at the Queen Elizabeth University Hospital in Glasgow for the West of Scotland, Royal Infirmary of Edinburgh for the Southeast of Scotland and Ninewells Hospital in Dundee for the North of Scotland. There will be cooperation between these to deliver a national 24/7 service.

Patients will usually be taken to their closest acute hospital (a spoke) which is able to carry out a computerised tomography (CT) brain scan (to exclude a bleed or non-stroke cause of symptoms) and a CT angiogram to identify whether the stroke is due to a large artery blockage which might be treatable with thrombectomy. Suitable patients will then be transferred to their nearest operational thrombectomy hub. We anticipate the majority of patients will then return to their spoke hospital stroke unit within 48 hours of treatment.

Additional funding has been made available in response to business cases to increase staffing and expand facilities across Scotland to be able to deliver the phased introduction of the Scotland-wide thrombectomy service.

Challenges

One of the biggest challenges to delivering a thrombectomy service is the availability of interventional neuroradiologists and interventional radiologists who are trained to do the procedure. Several interventionalists have been recruited and continue to be recruited and trained to be able to deliver a robust and reliable service. There have also been challenges in recruiting other key staff groups needed to deliver this service and thus expand the hours it is available.

In 2021, training continued to be delivered to stroke physicians, radiologists, interventional neuroradiologists, interventional radiologists, radiographers, stroke nurses, anaesthetists and many others who will be involved in identifying people for thrombectomy and delivering the treatment and its aftercare.

Pilots

Following the introduction of a pilot thrombectomy service in Ninewells Hospital in November 2020 initially just for patients presenting in NHS Tayside, this expanded during 2021 to include transfer of clinically suitable patients from Aberdeen Royal Infirmary and (early in 2022) patients from Victoria Hospital in Kirkcaldy.

Also in 2021, the service started at the Royal Infirmary of Edinburgh initially for patients presenting there but more recently including the transfer of suitable patients from St John's Hospital, Livingston. A test of change has also begun at the Queen Elizabeth University Hospital in Glasgow.

Currently all these services are only available within limited times. As experience, recruitment and training progresses, it is planned to extend the scope of the service to widen the hours that the service is available as well as include all hospitals in Scotland that receive patients with hyperacute stroke.

Key requirements

As with thrombolysis, time is critical. The benefit of treatment falls the longer it takes to deliver it from the onset of symptoms. Therefore, slick, efficient and safe pathways of care are required.

This is particularly challenging for thrombectomy as the pathway of care involves a wide range of services and professionals. These include SAS, emergency departments, radiology departments, stroke specialists, anaesthetists, interventional neuroradiologists or interventional radiologists, and stroke nurses who need to assess and discuss patients rapidly but safely including, in the future, out with normal working hours.

For those presenting to spoke hospitals, it also includes a transfer from this hospital to a hub that can deliver the service. As the service is introduced, this national report will in future years report on a number of key performance indicators to show how many people receive thrombectomy and the times taken for key parts of their treatment journey. As with other parts of the SSCA, these data will help inform where improvements can be made.

Discussion

Experience and learning from delivery of this new service in Scotland to date, alongside advice and experience from other countries or regions which already have established services, is being shared to help identify how the pathways of care can be improved.

Multidisciplinary communication tools and artificial intelligence software are being developed and tested to make patient pathways as slick and safe as possible.

We have gone from a position of thrombectomy not being available in Scotland at all to one where it is now available and has been delivered to a significant number of patients across all three of the hubs. It has been delivered in a relatively short time during the COVID-19 pandemic and has brought some well-publicised challenges.

Over the next few years, we look forward to continuing to expand the service so it is available to anyone who has a stroke clinically suitable for treatment wherever and whenever they have their stroke.

Access to stroke specialist clinic and carotid intervention

Access to stroke specialist clinic

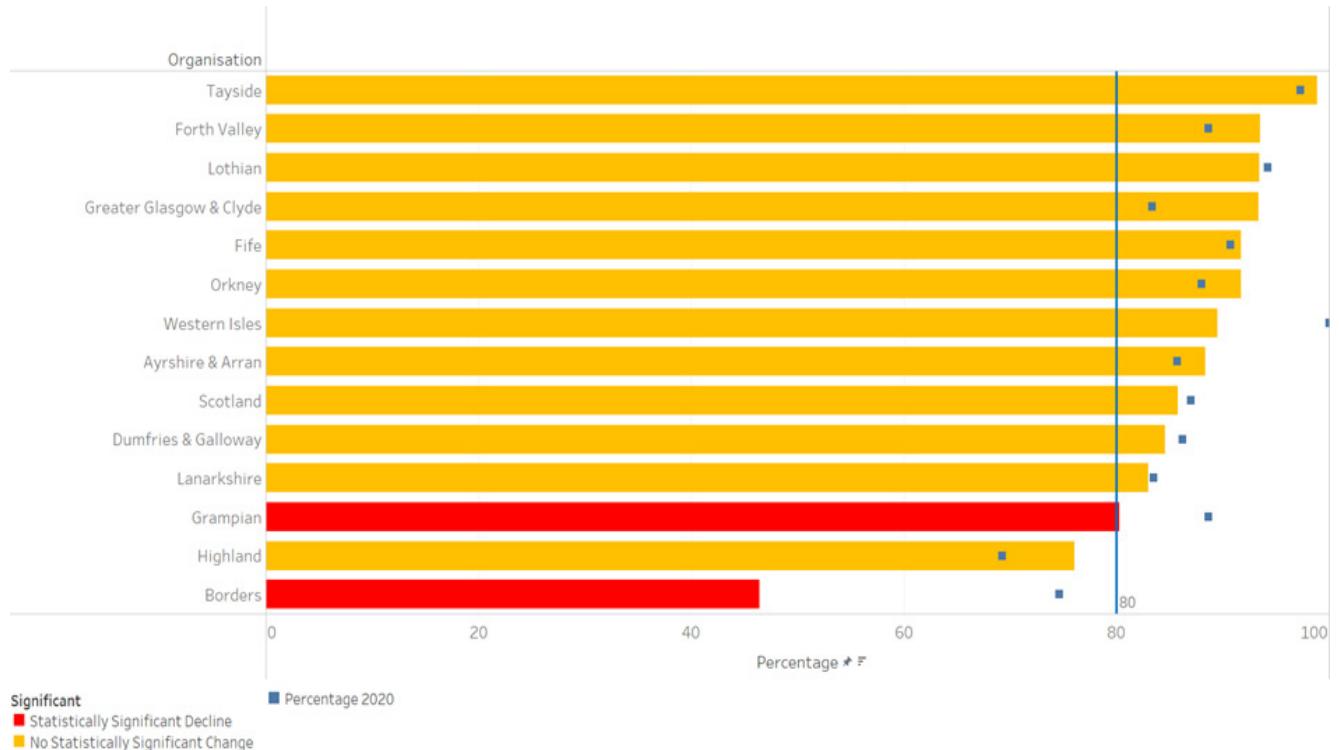
In Scotland in 2021, 86% of patients with a definite cerebrovascular diagnosis were seen at a specialist stroke/TIA clinic within 4 days of the date the referral (where the standard is 80%).

The majority of Health Boards, and individual hospitals, continue to meet the standard, as was the case in 2020.

Despite the COVID-19 pandemic, data contribution to the audit improved in 2021 when compared to 2020, with 3675 outpatients with a definite cerebrovascular diagnosis included in the 2021 audit compared to 2858 cases the year before. Although, data collection for this year was reduced in three Health Boards (six hospitals) and three hospitals did not contribute data to the current year.

There remains marked variation between hospitals with delays to initial clinic appointment/review and time to imaging.

Figure 37: Stroke patients seen in a stroke specialist clinic within 4 days by Health Board: 2021 (bar) compared to 2020 (square)

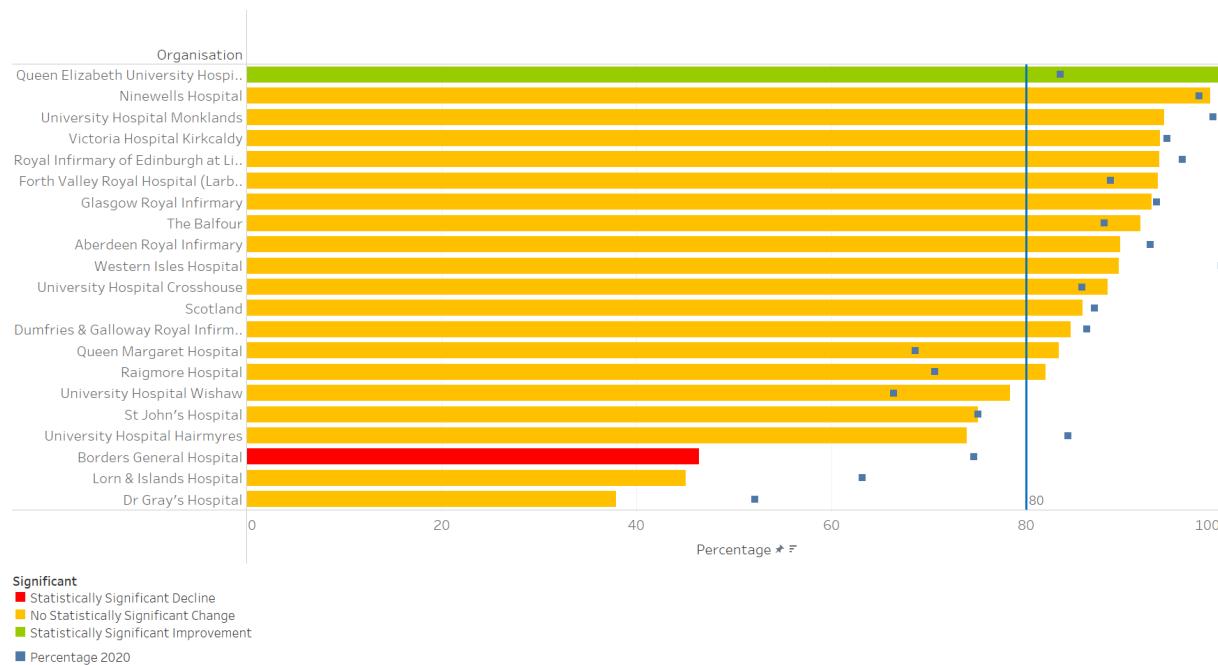


Notes: NHS Grampian showed a statistically significant decline but still met the 80% standard. NHS Highland and NHS Borders did not meet the standard, also seen in 2020. In addition, NHS Borders saw a statistically significant decline in performance compared to 2020. All other Health Boards showed no statistically significant change.

Three Health Boards contributed fewer than 20 outpatient cases to the 2021 audit – NHS Greater Glasgow and Clyde (15 cases), NHS Orkney (12 cases) and NHS Western Isles (19 cases).

Eleven of the 13 Health Boards met the standard of reviewing 80% or more of urgent outpatient referrals with a definite cerebrovascular diagnosis at a specialist Stroke/TIA clinic within 4 days of the date the referral was received (Figure 40).

Figure 38: Stroke patients being seen in a stroke specialist clinic within 4 days by site: 2021 (bar) compared to 2020



Notes: Borders General Hospital showed a statistically significant decline compared to 2020. All other hospitals showed no statistically significant change. Six hospitals contributed fewer than 20 patients to the 2021 audit – Queen Elizabeth University Hospital (1 case), Glasgow Royal Infirmary (14 cases), St John’s Hospital Livingston (4 cases), Balfour Hospital (12 cases) and Western Isles Hospital (19 cases).

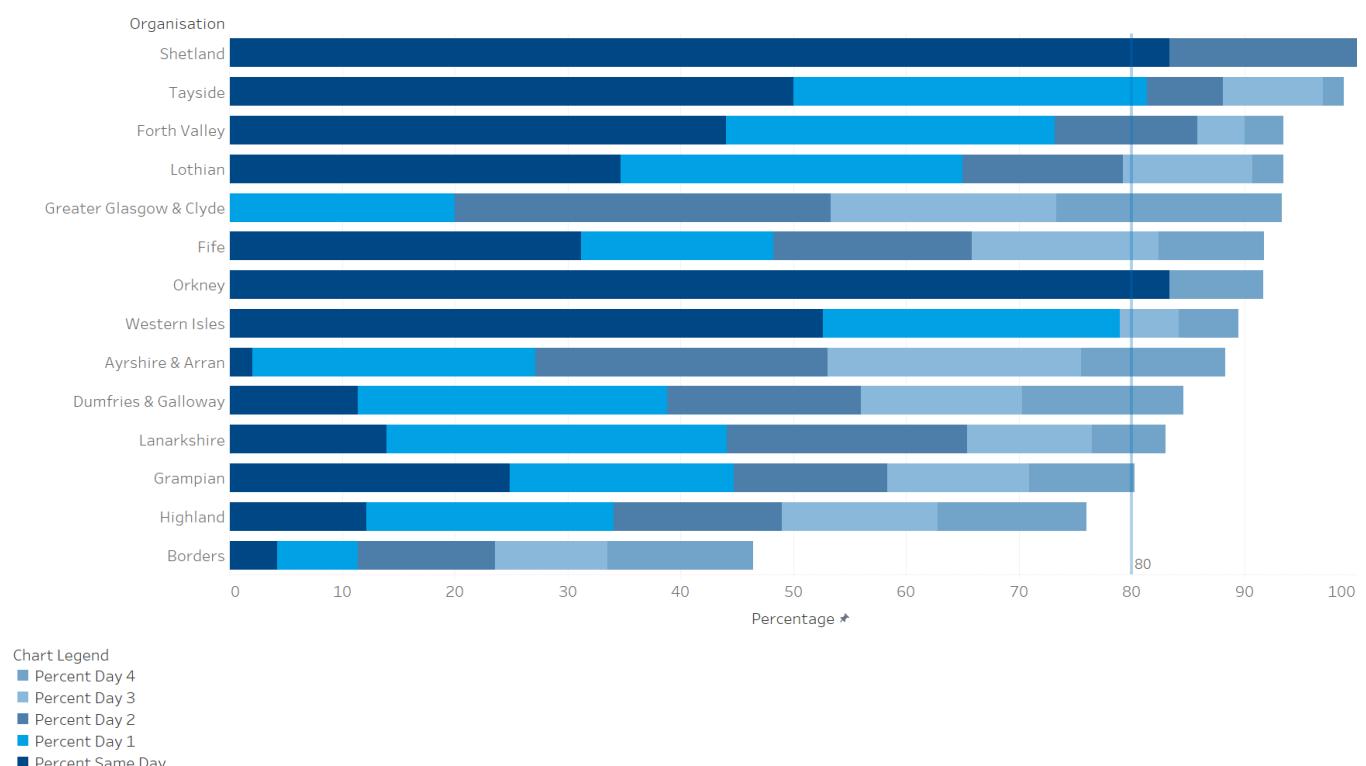
Fifteen out of 20 hospitals met or exceeded the standard of reviewing 80% or more of urgent outpatient referrals with a definite cerebrovascular diagnosis at a specialist Stroke/TIA clinic within 4 days of the referral being received (Figure 38).

For some, there were improvements when compared to 2020 (Queen Elizabeth University Hospital, Queen Margaret Hospital, Raigmore Hospital, University Hospital Wishaw), and for others a decline in performance (University Hospital Hairmyres, Lorn and Islands Hospital, Dr Gray’s Hospital), although none of these changes were statistically significant (Queen Elizabeth University Hospital data is based on a single case). Only Borders General Hospital had a statistically significant decline in performance in 2021 when compared to 2020.

The majority of hospitals contributed a higher number of cases to this year’s audit than in 2020. Data for 6 hospitals that contributed less than 20 patients to the current audit should be interpreted with caution (Glasgow Royal Infirmary, Queen Elizabeth University Hospital Glasgow, St John’s Hospital Livingston, Gilbert Bain Hospital,

Balfour Hospital and Western Isles Hospital). In addition, 3 hospitals did not contribute data to the 2021 audit, though had in 2020 (Royal Alexandra Hospital, Perth Royal Infirmary and Western General Hospital).

Figure 39: Patients seen in a stroke specialist/TIA clinic with 1 day, 2 days, 3 days and 4 days.



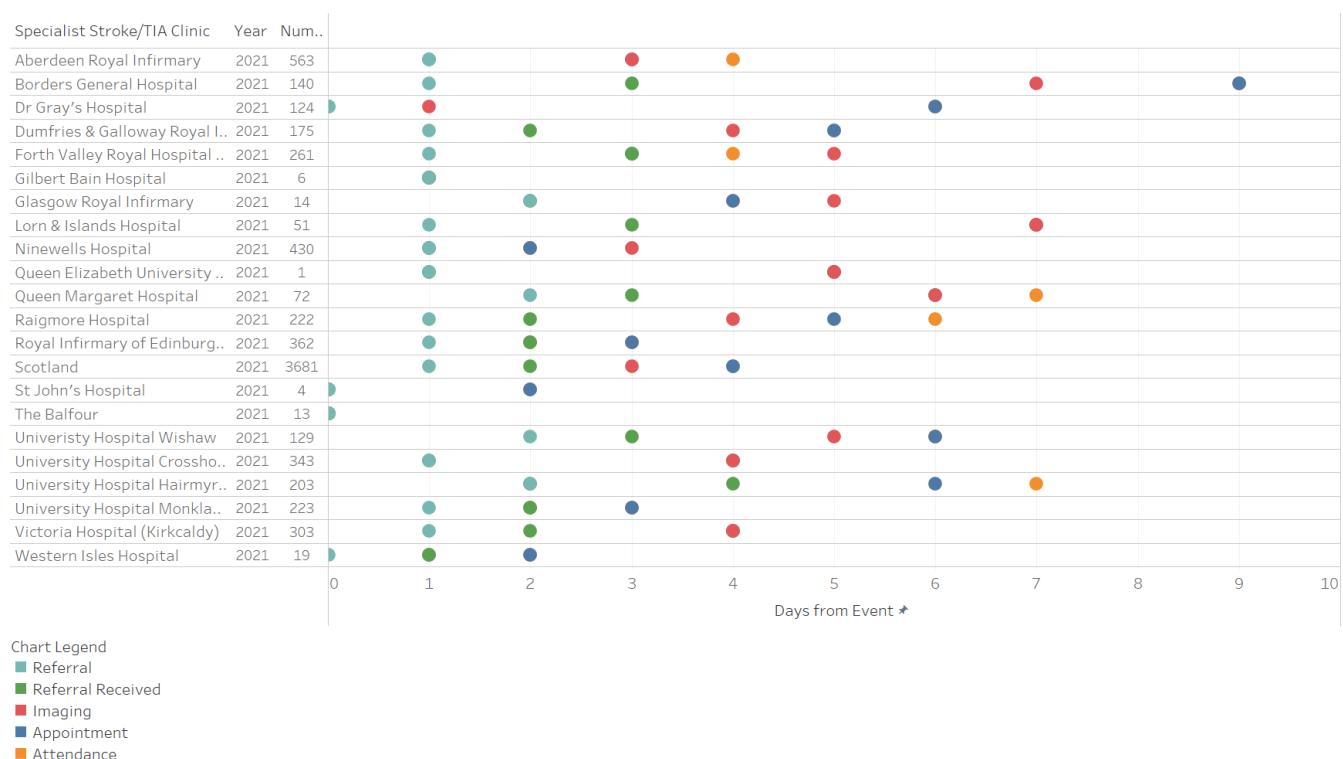
Notes

- The order of the graph matches the order of the key (starting with per cent same day on the left and per cent day 4 on the right)
- Six hospitals contributed less than 20 cases each - Caithness General Hospital, Dr Gray's Hospital, Gilbert Bain Hospital (6 cases), Glasgow Royal Infirmary (14), Queen Elizabeth University Hospital (1), St John's Hospital Livingston (4), Balfour Hospital (12) and Western Isles Hospital (19)
- Three hospitals did not contribute to the 2021 audit – Royal Alexandra Hospital, Perth Royal infirmary and Western General Hospital

Even though the majority of hospitals met the 4-day standard, there remains marked variation between individual hospitals in the time to cerebrovascular clinic review for patients with a definite cerebrovascular diagnosis from the date referral was received (Figure 39).

Variation also exists in time to brain imaging for outpatient referrals (Figure 40).

Figure 40: Median waits outpatient imaging and outpatient clinics



Notes

- Six hospitals contributed less than 20 cases each - Caithness General Hospital, Dr Gray's Hospital, Gilbert Bain Hospital (6 cases), Glasgow Royal Infirmary (14), Queen Elizabeth University Hospital (1), St John's Hospital Livingston (4), Balfour Hospital (12) and Western Isles Hospital (19)

A total of 24 hospitals provided data on time to brain imaging from date of referral (Figure 39). In 11 hospitals, patients had brain imaging mostly carried out before TIA clinic appointment or date seen (likely reflecting imaging being carried out at emergency departments prior to clinic referral being made). In the remaining 13 hospitals, the median interval between clinic appointment and following brain imaging

was 1 to 2 days. Twelve hospitals carried out brain imaging within a median of 5 days from their index clinical event. Overall, in Scotland, brain imaging was carried out within a median of 3 days from the date the referral was received.

Carotid intervention

There was a 20% increase in reported carotid endarterectomy cases in Scotland in 2021 compared to the previous year (294 cases versus 244 cases submitted in 2020).

Most endarterectomy centres submitted more cases than in 2020, except for Ninewells Hospital and Raigmore Hospital, which reported fewer surgical cases. No endarterectomy centre achieved the target of carrying out 80% of surgeries within 14 days from the time of the index stroke/TIA event in 2021, and there was no statistically significant change in performance in the centres compared to the previous year.

Figure 41: Stroke patients who received carotid intervention within 14 days of event by Health Board carrying out the procedure

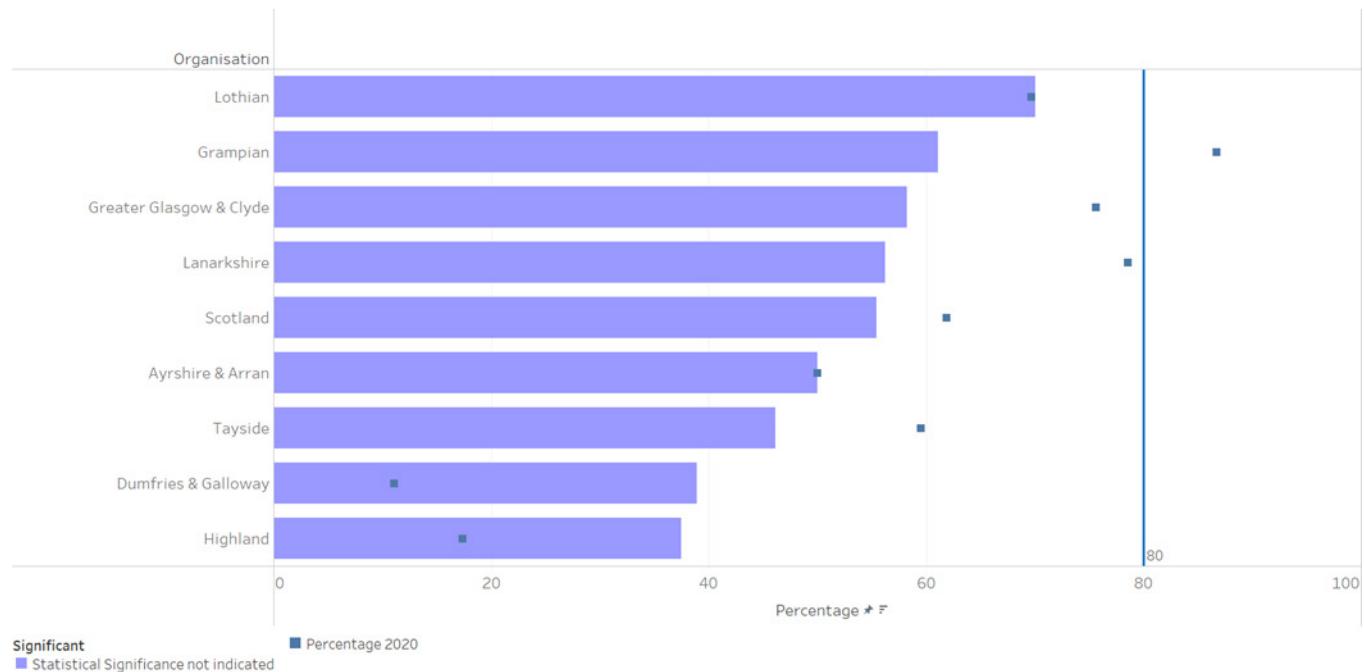
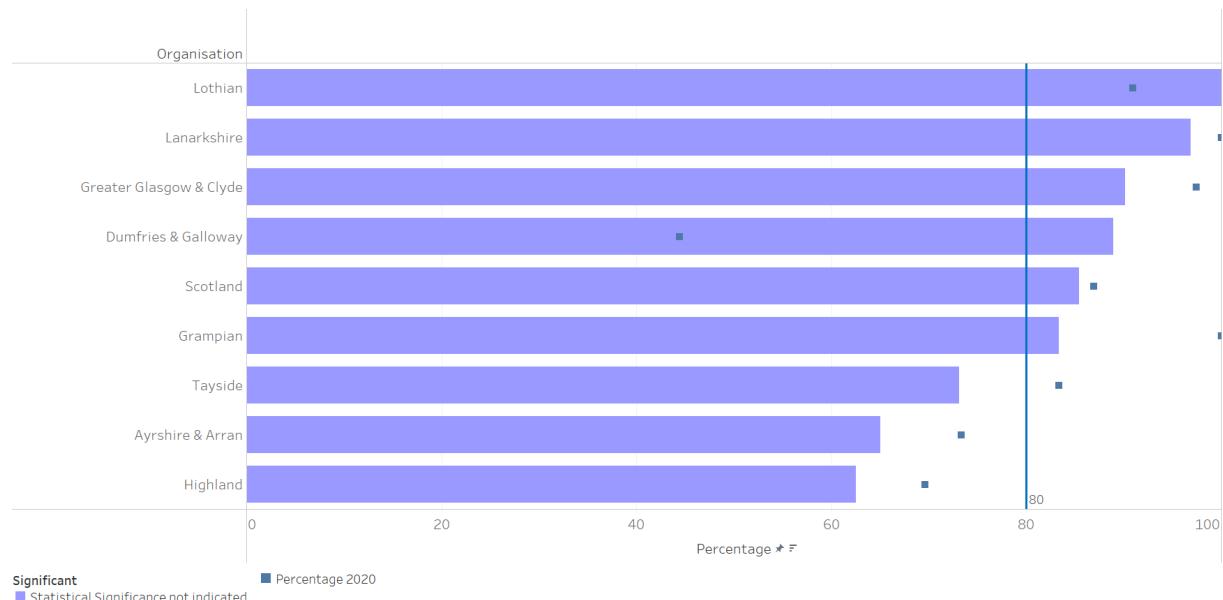


Figure 42: Patients receiving carotid intervention within 14 days since referral by Health Board carrying out the procedure



Notes

- Comparison data for eight centres. The graph shows the percentage of stroke patients (final diagnosis) receiving the stroke care standards, comparing last year (2021) (bar) against the preceding year (2020) (square) in relation to the expected 80% standard (vertical line)

No endarterectomy centre achieved the target of carrying out 80% of surgeries within 14 days from the time of the index stroke/TIA event in 2021 (Figure 41).

However, when the data is re-analysed using a revised target of 80% of cases having carotid endarterectomy within 14 days from the date the initial referral was initially received, six of the eight centres achieved this (Figure 42).

Rehabilitation

The provision of high-quality, evidence-based and person-centred stroke rehabilitation across the health and social care pathway is a priority within the Scottish Stroke Improvement Plan (SSIP). This means having equitable access to specialist stroke rehabilitation in an appropriate setting which reflects each person's needs and preferences.

Stroke rehabilitation should be delivered with enough frequency and intensity to be effective, supporting people who have had a stroke to maximise their physical and psychological recovery and to achieve meaningful outcomes.

SSIP performance targets currently reflect access to rehabilitation in inpatient settings, intensity of provision in stroke units, access to stroke specialist early supported discharge and community teams as well as a range of evidence-based stroke rehabilitation interventions. This will be revised and expanded to reflect the key elements of a holistic model of stroke rehabilitation including assessment, interventions, evaluation and the rehabilitation infrastructure that supports the provision of coordinated care.

The Programme for Government rehabilitation subgroup has defined what stroke rehabilitation services should look like as part of the progressive stroke pathway. The pathway focusses on person-centred rehabilitation. It is evaluated via the approach used by stroke rehabilitation services to deliver activities which are deemed to be central to person-centred care, including regular holistic assessment of need, goal setting and supported self-management as well as the patient experience of these activities.

The SSCA rehabilitation subgroup aims to:

- improve the delivery of stroke rehabilitation across the inpatient and community pathways
- further develop performance measures for stroke rehabilitation as part of the SSIP.

Outcomes

It is in the [2019 national report](#) that we last published stroke outcome data based on the 2018 data. Subsequently a change in analysts and then the COVID-19 pandemic have meant that it has not been possible to reliably produce this data again. The audit has kept its focus on auditing processes of care, which has been its primary goal since inception in the early 2000s.

Through 2020 it was often not possible for local audit coordinators to be physically present in stroke units meaning that audit data was collected remotely and this reduces confidence in some of the data, particularly data relating to case-mix, when the audit coordinators have less face-to-face interaction with stroke unit staff and patients.

In theory, the year 2021 will have been impacted upon by COVID19 issues in variable ways across the pandemic (as discussed earlier in this report). Some specific determinants of ability to rapidly discharge stroke patients with confidence, which may have been affected by the COVID19 pandemic, include the availability of social care staff and capacity within community rehabilitation and stroke early supported discharge teams. The 'negative' outlying Health Boards may wish to check their data completeness but will also wish to review their services to identify if and where there are system problems and how these might be resolved.

Services can choose to look at both unadjusted and adjusted (for age, sex, stroke type and six simple variables) as they see fit, with knowledge of their own local data completeness. The six simple variables seem to be a valid way to adjust for initial stroke severity.

'Home time' is the number of days those patients are at home in the first 90 days after their stroke. We believe that more home time would generally be valued by stroke patients.

Patients who rapidly recover, who are able to go home within the first few days, and who do not require readmission, or admission to a care home would accrue lots of home time, whereas patients who do not survive to be discharged home, who are

discharged to a nursing home, who have a prolonged length of stay in hospital, or who are readmitted having gone home will have fewer or even no home time. Research has shown that home time reflects how well the patients are functioning at 3 months after a stroke.

Figure 43: 90-day home time for 2021 admissions by Health Board (adjusted for age, sex and stroke type)

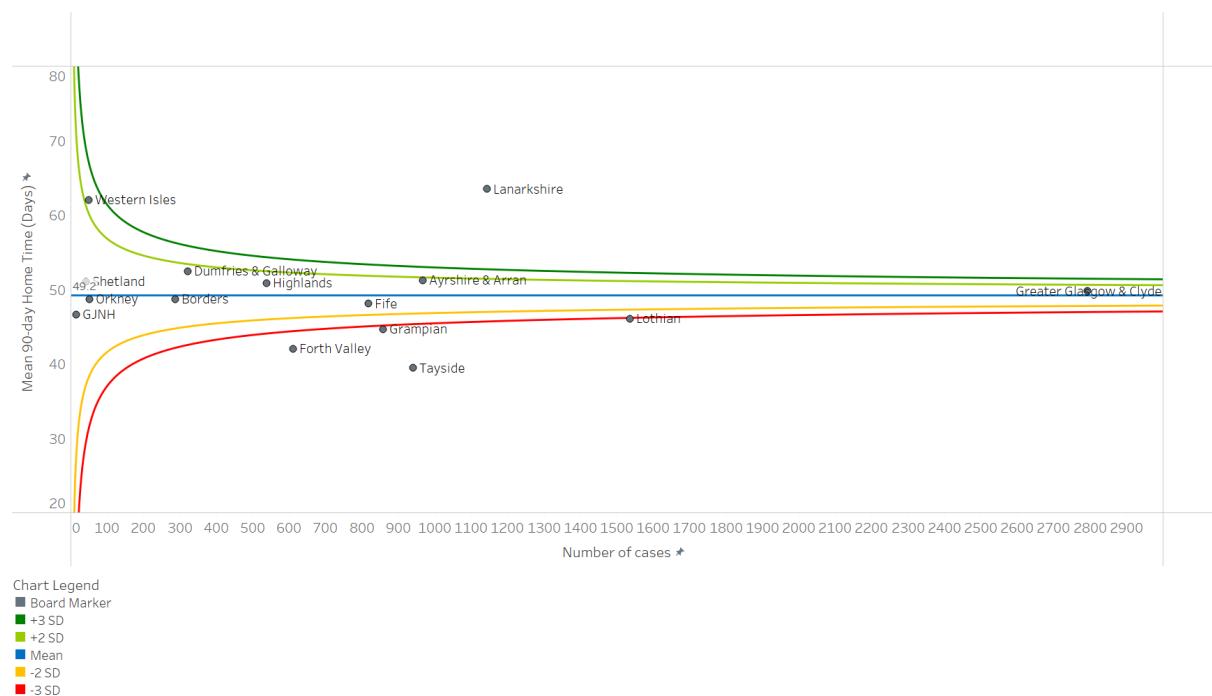


Figure 43 shows that for adjusted home time (adjusted means controlled for baseline factors such as age, sex and stroke severity) there are four ‘negative’ statistical outliers.

Tayside, Forth Valley, Grampian and Lothian have less home time on average than the rest of Scotland (generally meaning that more stroke survivors spend longer in hospital [or die or go to a nursing home] in the first 3 months after stroke admission than in other Health Board areas).

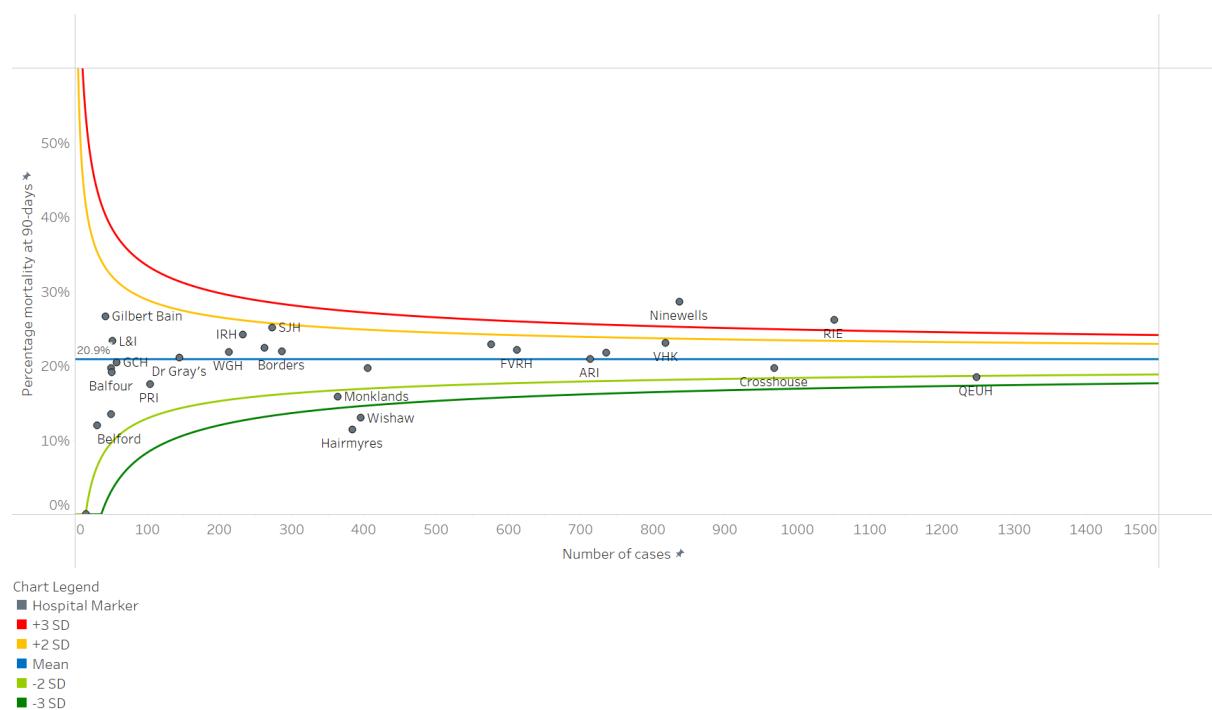
Only Tayside has been a ‘negative’ outlier in all of the last 3 years. Ninewells Hospital, compared to other hospitals, has a lot of missing case-mix adjuster variables (very simple things to collect) which might impact on their results reported here.

In theory, 2021 may have been impacted on by COVID-19 issues in variable ways across the pandemic. The ‘negative’ outlying NHS Health Boards may wish to check their data completeness but will also wish to review their services to identify if and where there are system problems and how these might be resolved.

NHS Lanarkshire is a ‘positive’ outlier for home time in 2021 and has been in all years since 2017. Patients seem to consistently spend more time at home in the first 3 months following stroke admission. Again, data completeness, including of collection of the case-mix adjustors, will need ongoing validation to ensure accuracy.

There are concerns that some major strokes may have been omitted from the analysis in 2021. However, the consistency of the result over 5 years suggests that it may be a real phenomenon.

Figure 44: 90-day mortality for 2021 admissions by NHS Health Board (adjusted for age, sex and stroke type).



Mortality data (Figure 44) can be difficult to interpret following stroke. Death may not be the worst possible outcome following a large disabling stroke, depending on patient and carers preference. A 3-month arbitrary cut off is used.

Patients may pass away after three months (and while still in hospital) and that might not necessarily be considered as a better outcome to dying before 3 months.

The mortality data shows that NHS Lanarkshire seems to have lower than average mortality in the first 3 months following stroke. NHS Tayside (predominantly data from Ninewells Hospital) and NHS Lothian (predominantly the Royal Infirmary of Edinburgh) have higher than average 3-month mortality.

As mentioned earlier in this section, NHS Tayside has a significant amount of missing data with regard to case-mix adjustors and will need to remedy this. This may alter their results.

Also, as discussed above, the NHS Lanarkshire data may have excluded some of the most severe strokes (who died very early after presentation). This could impact on their results and the Scottish mean and will need reviewed. Systems need to be put in place going forward to ensure data completeness.

In future reports we will continue to publish outcome data on a yearly basis. As the National Thrombectomy Service develops there will be more fluidity, with stroke patients frequently moving between NHS Health Boards and even regions. More sophisticated methods to capture this movement and feed implications of it into the outcome reporting will be required. It is expected that outcomes will need to be reported by first admitting hospital, or even by postcode, depending on thrombectomy developments.

Research

Routinely collected anonymised data remains an important resource for answering questions around the efficacy of patient care and service organisation.

Stroke remains one of the main causes of death in NHSScotland, and age-adjusted mortality rates are higher in Scotland than in the remainder of the UK.

While mortality rates have fallen over the past 10 years this seems to be levelling off, suggesting there is **further work to do to understand the different factors which influence mortality**.

As we reported last year, the SSCA dataset linked to other national datasets has been used to look at overall mortality and recurrent stroke.

Having confirmed that a recent diagnoses of cardiovascular disease or cancer are not surprisingly associated with poorer outcomes after stroke, we are now exploring the interactions between cancer and stroke in more detail.

A **systematic review of 36 studies** suggests stronger associations between ischaemic stroke and certain cancers, and that risk of stroke is highest within the first 6 months of stroke diagnosis. A Chief Scientist Office funded study using an anonymised and linked dataset held within the National Safe Haven is now analysing the rates of stroke in cancer patients and the frequency and type of new cancer diagnosis after stroke in the Scottish population.

Appropriate prescribing of secondary prevention medication after stroke is known to reduce the risk of recurrent stroke and other vascular events.

We have previously reported that blood pressure medication is probably under-prescribed after stroke. Further analysis suggests that discontinuing blood pressure medication or blood thinners after stroke is associated with higher mortality at one year even after correcting for age, sex and stroke severity.

An updated Chest Heart and Stroke Scotland dataset with linkage up to 2020 is now being analysed to assess the impact of frailty or comorbidities on prescribing and

stroke outcomes, and some of these data will be presented at the UK Stroke Forum in December.

The SSCA dataset is also part of a big data project to explore the interactions between COVID-19 and cardiovascular conditions. This is funded by the British Heart Foundation and covers the four nations of the UK. Information is available on the [Health Data Research UK website](#).

Next steps

The SSCA and the Scottish Stroke Improvement Plan will continue to review the data we collect so we can reflect the journeys of stroke patients in Scotland. This will be guided by the [progressive stroke pathway](#) which was published on 22 March 2022.

This document, produced by the National Advisory Committee for Stroke, sets out a vision of what progressive stroke care in Scotland should comprise, and, as an audit, we must reflect this.

One of our aims will be to produce a TIA bundle, and to continue to build on the data collection for thrombectomy. This is so we can continue to assist Health Boards, as they gradually return to pre-pandemic activity.

Furthermore, we will develop extra validations so that we can ensure data completeness and accuracy, and, with linkage to the Scottish Morbidity Record, build on our existing data completeness.

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Further information

Further information and data for this publication are available from the [publication page](#) on our website (www.strokeaudit.scot.nhs.uk/index.html).

The next release of this publication will be June 2023.

Rate this publication

Let us know what you think about this publication via. the link at the bottom of this [publication page](#) on the PHS website.

Appendices

Appendix 1 – Background information

The SSCA monitors the quality of care provided by the hospitals in all Health Boards by collating data collected by the stroke managed clinical networks (MCNs).

Appropriate care is measured using the stroke care bundle, which comprises four key components: admission to a stroke unit, swallow screen, brain scan and aspirin. Not all patients are eligible for all four components. These data are used by the Scottish Government to monitor progress against the Scottish Stroke Care Standards (2018) and the Scottish Stroke Improvement Plan (2014).

The stroke care bundle is important because achieving it is associated with a reduced risk of dying and an increased likelihood of getting back home. Health Boards are expected to identify aspects of their stroke services which do not meet the Scottish standards and to work with their stroke MCNs to improve their standards of care locally.

Further information will be available on the day of publication with additional Tableau dashboards.

Appendix 2 – Publication metadata

Publication title

Scottish Stroke Improvement Plan Annual Report 2022.

Description

The SSCA monitors the quality of care provided by the hospitals in all Health Boards by collating data collected by the stroke managed clinical networks (MCNs).

Theme

Healthcare audits.

Topic

Stroke.

Format

PDF and Tableau dashboards are available on the day of publication.

Data source(s)

The Electronic Stroke Care Audit Database.

Date that data are acquired

31 March 2021.

Release date

28 June 2022.

Frequency

Annually.

Timeframe of data and timeliness

1 January 2021–31 December 2021.

Continuity of data

No known issues.

Concepts and definitions

This is available on the [Stroke Audit website](#).

Relevance and key uses of the statistics

This publication is intended to support the Scottish stroke improvement plan, and to facilitate improvement in the care of stroke patients in Scotland.

Accuracy

Audit data are subject to validation at data entry and quality assurance procedures. This release is intended to provide the public with timely information on COVID-19 and validation is ongoing.

Completeness

Data on patients who have a final diagnosis of stroke have been collected in every Health Board in Scotland. These are then compared to SMR01 data to ensure that no patients have been missed.

Comparability

Sentinel Stroke National Audit Programme publish data relating to the care of stroke patients in the rest of the UK,

Accessibility

It is the policy of Public Health Scotland to make its websites and products accessible according to published guidelines. More information on accessibility can be found on the [PHS website](#).

Coherence and clarity

This report is released in a PDF format, but also a tableau report if additional information is required.

Value type and unit of measurement

Counts of admissions, rates of admissions, mean time, percentage of compliance.

Disclosure

The PHS Protocol on Statistical Disclosure is followed.

Official Statistics designation

Management Information.

UK Statistics Authority Assessment

None required.

Last published

27 June 2021

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June 2022.

Date of first publication

30 September 2008.

Help email

phs.strokeaudit@phs.scot

Date form completed

09 June 2022.

Appendix 3 – Early access details

Pre-Release Access

Under terms of the "Pre-Release Access to Official Statistics (Scotland) Order 2008", PHS is obliged to publish information on those receiving Pre-Release Access ("Pre-Release Access" refers to statistics in their final form prior to publication). The standard maximum Pre-Release Access is five working days. Shown below are details of those receiving standard Pre-Release Access.

Standard Pre-Release Access

Scottish Government Health Department

Health Board Chief Executives

Health Board Communication leads

Early Access for Management Information

These statistics will also have been made available to those who needed access to 'management information', ie as part of the delivery of health and care:

National Advisory Committee for Stroke

SSCA Steering Group

Stroke Managed Clinical Networks

Early Access for Quality Assurance

These statistics will also have been made available to those who needed access to help quality assure the publication:

Stroke Managed Clinical Networks and those associated with these.

Appendix 4 – PHS and Official Statistics

About Public Health Scotland (PHS)

PHS is a knowledge-based and intelligence driven organisation with a critical reliance on data and information to enable it to be an independent voice for the public's health, leading collaboratively and effectively across the Scottish public health system, accountable at local and national levels, and providing leadership and focus for achieving better health and wellbeing outcomes for the population. Our statistics comply with the **Code of Practice for Statistics** in terms of trustworthiness, high quality and public value. This also means that we keep data secure at all stages, through collection, processing, analysis and output production, and adhere to the '**five safes**'.

Appendix 5 - SSCA Report Writing Group

Name	Organisation	Role
Mark Barber	NHS Lanarkshire	Consultant Geriatrician, Stroke MCN Clinical lead and Clinical Lead/Chair of the SSCA
Katrina Brennan	NHS Lanarkshire/Scottish Government	MCN Manager and Scottish Stroke Improvement Lead
Pamela Maclean	Public Health Scotland	Regional Coordinator
Mary-Joan Macleod	NHS Grampian and the University of Aberdeen	Consultant Physician, Senior Lecturer in Clinical Pharmacology and Chair of the SSCA Research Sub Group
Neil Muir	Public Health Scotland	Clinical Coordinator
David Murphy	Public Health Scotland	Senior Information Analyst
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Peter Langhorne	University of Glasgow and NHS Greater Glasgow and Clyde	Professor of Stroke Medicine and Consultant Physician.
Philip Birschel	NHS Lanarkshire	Consultant Care of the Elderly and Stroke
Scott Faulds	Public Health Scotland	Information Analyst
Fiona Wright	NHS Greater Glasgow and Clyde	Consultant Stroke Physician, Deputy Advisor to the Chief Medical Officer and Chair of the MCN Managers and Clinical Leads Group
Therese Lebedis	NHS Grampian	Consultant Occupational Therapist in Stroke and Chair of the Rehabilitation Subgroup
Craig Henderson	Scottish Ambulance Service	Clinical Improvement Lead

Name	Organisation	Role
Andrew Kent	Scottish Ambulance Service	Principal Clinical Outcomes Analyst
Johanne Burns	Scottish Ambulance Service	Information Analyst
Gareth Clegg	Scottish Ambulance Service	Deputy Medical Director for Scottish Ambulance Service