Management of Epilepsy and Seizures in Older People

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Master in Philosophy

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Abstract

Aims

To determine whether there is variability in the care and management of patients with seizures and epilepsy, when comparing those aged 60 and over to those under 60.

Review whether there has been change in referral rates and pattern of referral for older patients with seizures presenting to emergency departments (ED).

Assess yield of CT head imaging carried out in patients with known epilepsy.

Methods

Patients aged 60 and over were compared to those under 60 recruited to National Audit of Seizure Management in Hospitals 2 (NASH2). NASH2 assessed care antecedent to the presenting seizure, care at hospital, in the emergency department, medical wards as well as future plans for the patient. Data collection was carried out between June to September 2013. Statistical analysis was carried out using GraphPad Prism.

Two retrospective case note audits were also carried out, using the same clinical questions as NASH2 reviewing the care of all patients aged 60 and over, attending University Hospital Aintree (UHA) and Royal Liverpool University Hospital (RLH) ED, from December 2014 to June 2015, presenting with a seizure. CT scans, of patients with known epilepsy were reviewed to assess yield of imaging.

Results

1256 patients, aged 60 and over, were recruited in NASH2 and included for analysis. 110 patients attending University Hospital Aintree and 60 patients attending Royal Liverpool Hospital were identified.

Results from NASH2 showed that 80% of patients aged 60 and over and 55% of those under 60 presenting with a likely first seizure were admitted to hospital ($p<0.001$).

CT head imaging in patients with epilepsy in NASH 2 was carried out in 35% of patients aged 60 and over compared to 17% of those under 60 ($p<0.001$).

Review of CT imaging in patients with epilepsy at UHA showed that 97% had no new abnormalities. The findings at RLH were similar with 92% of patients with epilepsy having no new abnormalities on CT imaging.

34% of patients aged 60 and over with a likely first seizure in NASH2 were referred to a specialist on discharge, compared to 68% of patients under 60 ($p<0.001$).

27% of patients with a likely first seizure attending UHA and 43% attending RLH were referred to a neurologist or epilepsy specialist on discharge. Referral to other specialties was made in 14% of those with a likely first seizure presenting to UHA and 18% of those presenting to RLH.

Conclusions

Older patients presenting with seizures are more likely to be admitted to hospital and have imaging. They are less likely to be referred to specialist services on discharge. There appears to be significant disparity in referral rates when comparing those aged 60 and over to the under 60s, with those aged 60 and over less likely to be referred.

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Chapter 1. Introduction

The proportion of the world's population aged 60 and over will nearly double from 12% to 22% from 2015 to 2050. By 2050 the number of people aged 60 and over will outnumber children younger than 5. (1) The incidence of epilepsy varies with age and peaks in children and older people. Epilepsy is the third most common neurological condition, following dementia and stroke in this group. (2, 3)

The ageing population present a unique set of challenges to clinicians, both in terms of diagnosis, treatment and long-term management. Guidance on diagnosis and management of epilepsy and seizures in older people remains limited, with minimal guidance offered by the National Institute for Health and Care Excellence (NICE). Whilst the Scottish Intercollegiate Guidelines Network (SIGN) on management of older people with epilepsy provides more guidance this only highlights certain aspects of management. (4, 5)

1.1 Epidemiology

Chronic neurological disorders, including epilepsy, account for a significant proportion of the world's disease burden. The Global Burden of Disease Study was a comprehensive analysis of the burden of 291 diseases and injuries, and 67 risk factors, in 187 countries and 21 world regions comparing the years 1990, 2005 and 2010. The burden of disease was measured by disability-adjusted life years (DALYs). Mental, neurological and substance use disorders were the fifth cause of DALYs. Neurological disorders accounted for 3% of DALYs, a quarter of these were due to epilepsy. (6-8)

Among neurological diseases, epilepsy accounts for the highest age-standardised DALY rates both in men and in women, followed by migraine and Alzheimer's disease (AD). Epilepsy accounted for 0.7% of total DALYs, with a 16% increase of

DALYs observed in both men and in women when comparing 1990 and 2010. This increase is largely due to changes in population growth and ageing. (6-8)

1.1.2 Prevalence of epilepsy

The estimated median worldwide incidence of epilepsy is 50.4 per 100,000 population per year. (9) Significant differences can be found when comparing developing to developed countries (incidence, 81.7 vs. 45.0). The differences can in part be explained by the level of income in the country. Similarly the higher incidence of traumatic brain injury and infections may contribute to the increased incidence of epilepsy in some areas. (3)

Older people are more likely to develop seizures and epilepsy than their younger counterparts. The annual incidence of epilepsy rises from 85.9 per 100 000 people in those aged over 65 to more than 135 per 100 000 people in those over 80. (2, 3, 10, 11)

The increase in the incidence of epilepsy with age is largely explained by the increased incidence of common clinical conditions in older people, such as neurodegenerative disorders and stroke. (12) Acute symptomatic seizures are also more common in older people, adding to the burden of disease. (13)

1.1.3 Comorbidities and mortality in epilepsy

A comorbid condition is one that occurs during the course of a pre-existing disease. (14) Comorbidity increases in the elderly with 30.4% of adults aged 45 to 64 years reporting at least two chronic conditions, increasing to 64.9% of adults aged 65 to 84 years and more than 80% for those above 85 years old. (15) Almost all deaths in people with epilepsy are related to other comorbidities of epilepsy, such as cancer, cardiovascular, or cerebrovascular disease. (16, 17)

Population-based studies report an increased risk of premature mortality among people with epilepsy compared to the general population. Pooled mortality was threefold, relative risk 3.33 (95% confidence interval 2.83–3.92) of observed deaths in epilepsy compared to that expected in the general population. (17, 18)

For individuals with symptomatic epilepsy, around three-quarters of deaths within one year of epilepsy onset, are directly related to the underlying cause of epilepsy, for individuals with symptomatic epilepsy, rather than seizure-related causes. (19)

Data from the National General Practice Study of Epilepsy, a community-based UK study with almost 25 years of follow-up, has shown that people with epilepsy are more likely than the general population to die of malignant neoplasms, ischaemic heart disease, cerebrovascular disease, and pneumonia, after controlling for the effects of age, sex, and calendar year. (20)

Epilepsy itself carries a significant risk of premature death and sudden unexplained death in epilepsy (SUDEP). (21, 22) A pooled analysis of population-based studies showed that SUDEP has an estimated overall crude annual incidence rate of 0.81 cases per 100,000 population, or 1.16 cases per 1,000 patients with epilepsy. Although the rate of SUDEP declines in the sixth decade, SUDEP still contributes to mortality in this group. (23)

The frequency of status epilepticus and incidence per 100,000 individuals is highest in the first year of life and in individuals aged 60 and over. 30% of older patients presenting with seizures do so in status epilepticus, with associated mortality rates of 38%. (24)

1.2 Causes of epilepsy in older people

1.2.1 Cerebrovascular disease

People with epilepsy have higher rates of heart disease, stroke, as well as hypertension, diabetes mellitus and hyperlipidaemia. (25-29) The occurrence of epilepsy in older people should lead to investigation for underlying cerebrovascular disease.

A retrospective review of stroke admissions to hospital found that epilepsy was more common in the stroke group compared to controls, suggesting that seizures were a possible predictor of future stroke. (30)

A further study looking at the risk of stroke in adults aged 60 and over following a seizure confirmed a substantial risk of stroke at any point when comparing those who developed seizures to controls (hazard ratio [HR] = 2.89). (31)

When assessing time to stroke following initial diagnosis of epilepsy, another study found that onset of stroke between six months and one year after the first diagnosis, occurred in a significantly higher proportion of cases with epilepsy (16.2%) than controls (10.9%). The median time to stroke was significantly shorter in cases with epilepsy (2.7 years) when compared to controls (3.2 years). (32)

Acute seizures following stroke have been defined as occurring between 2-4 weeks later. (33) Risk factors for post stroke epilepsy include haemorrhagic stroke, as well as stroke severity and location. Local factors such as ischaemia, oedema, cytotoxicity, and altered neurotransmitter activity, are thought to be implicated in seizure occurrence. (33-36)

Some studies also suggest that the risk of epilepsy is higher in patients with late onset seizures following stroke. (30, 37, 38) A prospective multicentre study showed that 8.9% of patients had seizures following stroke, of these 10.6% had a

haemorrhagic stroke and 8.6% ischaemic stroke. Late onset of first seizure was shown to be an independent risk factor for epilepsy after ischaemic but not after haemorrhagic stroke. (39)

Focal neurological symptoms can lead to a diagnosis of transient ischaemic attacks (TIA) rather than seizures, and vice versa. The duration of symptoms is helpful at reaching a diagnosis, a shorter duration typically less than five minutes is more suggestive of seizures than TIAs. Patients who have been diagnosed as having TIAs who describe concurrent loss of awareness should be re-assessed for seizures. (40)

1.2.2 Neurodegenerative conditions

In Europe the prevalence of dementia is estimated to be approximately 6–8% after 65 years of age and may rise to 20–30% in subjects older than 85. (41, 42) Although Alzheimer's disease (AD) is the most common form of dementia, other causes include, vascular disease, frontal lobe dementia and Lewy body disease. (43)

The aetiology of seizures in individuals with AD remains unclear and several mechanisms have been suggested, including deposition of β-amyloid in the brain, leading to cognitive impairment and seizures. (44) Seizures have also been observed in patients with vascular dementia, where cerebrovascular disease is felt to play a part. (45)

Age is a common factor for both epilepsy and dementia. Several studies have noted a significantly higher incidence of seizures and epilepsy in patients with dementia. Patients with AD are up to ten times more likely to develop epilepsy than those without. (46-50)

In a prospective study of 453 patients with mild AD, 2% had an unprovoked seizure by 5 years of follow-up, this is 8 times higher when compared with the general population. (51, 52)

The diagnosis of AD has consequences with regards to quality of life, morbidity and it can also lead to increase in mortality in individuals with both conditions. (53)

Other independent risk factors for seizure include degree of cognitive impairment and history of antipsychotic use. (54) Some drugs used for treatment of AD have been associated with an increased risk of seizure by lowering seizure threshold, including typical neuroleptics and the antidepressant bupropion. (55)

Acetylcholinesterase inhibitors are the mainstay of current symptomatic treatments for patients with AD. A randomised, double-blind, placebo-controlled study of donepezil, an acetylcholinesterase inhibitor, in patients with epilepsy did not reveal an increased frequency of seizures. (56) Memantine, a non-competitive NMDA receptor antagonist, has been reported to have both anti-convulsant and pro-convulsant effects in rats. (57)

Anti-epileptic drugs (AEDs) particularly if used in combination can lead to significant cognitive side effects, making this a particular consideration when choosing AEDs in individuals with pre-existing cognitive impairment. (58) Lamotrigine appears to have a more favourable cognitive profile. (59) Conversely topiramate can cause effects on attention, verbal function and language (60) There is paucity of data on cognitive side effects of AEDs. However general principles on the use in this group should include slow titration and avoidance of multiple AEDs where possible.

1.2.3 Trauma

Traumatic brain injury (TBI), has a higher occurrence and poorer prognosis in older people. (61) Up to 20% of cases of epilepsy in older people can be attributed to TBI. (62) A study of young adults and children found a strong correlation between the severity of TBI and the risk of subsequent unprovoked seizure. The risk remained elevated for more than 10 years, compared to people without TBI. (63)

Risk factors for subsequent epilepsy include, subdural haematoma, contusion, skull fracture, loss of consciousness, amnesia for more than a day, as well as those aged 65 or older. (64)

1.2.4 Acute symptomatic seizures

The incidence of acute symptomatic seizures in patients older than 60 is approximately 100 per 100,000 population and increases with each decade of advancing age. (13, 65, 66) Acute symptomatic seizures represent approximately 40% of all cases of non-febrile seizures in developed countries, and more than half in some geographic areas, where cysticercosis is endemic. (67, 68)

Traumatic brain injury, cerebrovascular disease, drug withdrawal, infection, and metabolic insults represent the commonest causes for acute symptomatic seizures. The peak incidence of seizures related to alcohol withdrawal occurs in late adult life. (69, 70)

Medications that lower the seizure threshold are an important cause of acute seizures. Drugs such as antipsychotics, antidepressants, theophylline, levodopa, thiazide diuretics and antibiotics have been reported to induce seizures. All barbiturates and benzodiazepines present a risk of withdrawal seizures. (71-74)

Acute symptomatic seizures arising from metabolic conditions are common in patients older than 60. Several conditions can precipitate seizures. Hypoglycemia associated with insulin use and non-ketotic hyperglycemia are often reported causes of seizures in diabetic patients. (75, 76) Uraemia, hypocalcaemia and hyponatremia can also promote seizures. (77) Similarly central nervous system and systemic infections, such as meningitis, pneumonia, and urinary sepsis, can provoke seizures. (78)

Short-term mortality is fairly high after an acute symptomatic seizure and a first episode of status epilepticus. (66) 30% of acute seizures in older people presented as status epilepticus (SE), which is twice the incidence of SE in the general population. (79)

1.2.5 Tumours

Between 10% and 30% of seizures are associated with tumours, brain metastases, meningiomas, and gliomas. (65) Seizures are more commonly seen in low-grade tumours rather than high-grade tumours and in primary brain tumours rather than secondary. (80) Older people with brain tumours are less likely than younger patients to present with seizures, however age is a risk factor for increased mortality in people who do develop seizures. (81)

1.3 Diagnosis

Studies carried out in various settings have reported epilepsy misdiagnosis rates of between 4.6% and 30%. (82) Specialists have lower misdiagnosis rates than non-specialists, with a misdiagnosis rate of 5.6% for neurologists compared with 18.9% for non-specialists. (83) The need for review by a specialist for diagnosis and management of epilepsy is recommended by both SIGN and NICE, with the latter suggesting referral to a tertiary neurosciences unit if diagnostic doubt persists. (4, 5)

The diagnosis of epilepsy can be even more challenging in older patients, making this group prone to both underdiagnosis and overdiagnosis. The true extent of misdiagnosis remains unclear and consequently the exact prevalence of epilepsy in older people remains difficult to quantify. (12)

In the Veterans Affairs Cooperative Study of epilepsy in older people, epilepsy was not considered in 26% of initial medical evaluations of older patients who were

eventually diagnosed with epilepsy. Alternative diagnoses considered were altered mental status (41.8%), blackouts (29.3%), syncope (16.8%), confusion (37.5%), memory disturbance (17.2%), dementia (6.9%) and dizziness (10.3%). (84)

The lack of typical clinical signs in older people who have had a seizure, may lead to delayed diagnosis and treatment. Several factors contribute to the difficulties in diagnosis and recognition of seizures in this group, including lack of awareness and understanding of the symptoms, by both patients and carers, leading to under reporting of events to clinicians. Variability in clinical presentation of seizures and comorbid medical disorders also make diagnosis difficult. Lack of knowledge about epilepsy and lack of training in diagnosis and management can also reduce clinicians' ability to reach a diagnosis. (85)

The symptoms of epilepsy in older people are often attributed to other comorbid conditions. 13% of patients admitted with a diagnosis of stroke, to an acute stroke unit had an incorrect diagnosis. 39% of these patients had unrecognised seizures rather than stroke. (86) Post ictal focal motor deficits may last for several hours which can mistakenly lead to a diagnosis of ischaemic stroke. (87)

Overdiagnosis of transient ischaemic attacks (TIAs) has been reported in older people, particularly in patients who have a previous diagnosis of TIAs. For older patients with a previous diagnosis of TIA or stroke time to diagnosis of epilepsy was 1.7 years. (88)

Overdiagnosis of syncope has also been noted and felt to be primarily due to high prevalence of false positives in tilt table testing, carotid sinus massage and electrocardiographic monitoring. (89)

Medical literature focuses more on clinical features that are useful in establishing or excluding a diagnosis of syncope rather than on making a diagnosis of seizures or epilepsy. Furthermore, there is little information specifically relating to the clinical features of seizures in older people. A scoring system based on common clinical

features has been proposed to distinguish syncope from seizures with 94% sensitivity and specificity. (90)

Seizures in older people can be atypical with non-specific symptoms and signs. Auras are less commonly reported. Up to one-third of patients experience focal seizures with loss of awareness. Older people may have more prolonged periods of post ictal confusion and automatisms may not be as prevalent. Tongue biting and urinary incontinence may also be absent. (87)

Seizures can also be a presenting feature of autoimmune encephalitis (AE). The diagnostic criteria for AE include progressive working memory deficits, altered mental status or psychiatric symptoms. These should be accompanied by at least one of the following; new focal clinical findings, seizures not explained by a previous known seizure disorder, cerebrospinal fluid pleocytosis, and MRI features suggestive of AE. (91)

Whilst auto-antibody testing is useful to allow prognostication and potentially identify underlying aetiology, it is important to treat suspected individuals with AE early with immunotherapy, and not wait for antibody results, particularly given that these patients are often immunotherapy-responsive.
(91, 92)

1.3.1 Confusional states

Prolonged confusion might be a feature of the ictal or post-ictal phases in older patients with epilepsy. Transient confusion should always prompt consideration of focal seizures. In patients with pre-existing dementia confusional states can be particularly challenging to diagnose. (93)

Non-convulsive status epilepticus (NCSE) should be considered in patients presenting with altered mental status. Older patients are at particular risk of misdiagnosis given the lack of motor signs and broad range of presentations. (94)

Similarly it is important to consider this diagnosis in patients with a low Glasgow coma scale (GCS) and therefore an early electroencephalogram (EEG) should be considered in these patients. (79, 95)

Several conditions with episodic neurological symptoms or loss of consciousness can be mistaken with epilepsy. Transient global amnesia (TGA) is characterised by abrupt-onset anterograde amnesia, with a duration of 1-12 hours during which time there is repetitive questioning without impairment in consciousness. (96) TGA is usually an isolated event with recurrence being uncommon. (97) TGA should be distinguished from focal seizures with loss of awareness or from transient epileptic amnesia, which typically lasts less than an hour and can reoccur. (98)

The prevalence of epilepsy in the migraine population, ranges from 1% to 17% and the frequency of migraine in epileptic populations, ranges from 8.4% to 20%. (99)

Studies have found that whilst neocortical cellular excitability is apparent in both, in migraine the hyperexcitability is believed to transition to cortical spreading depression, rather than to the hypersynchronous activity that characterizes epilepsy. Some forms of epilepsy and migraine are known to be channelopathies and genetic mutations can lead to epilepsy, migraine or both. (100)

Whilst epilepsy and migraine can be easily differentiated, difficulties can arise when distinguishing migrainous visual aural from occipital lobe seizures, and therefore a detailed description of the visual phenomena is particularly important. (101)

1.3.2 Sleep disorders

Rapid eye movement sleep behaviour disorder (REMSBD) is a type of parasomnia that usually presents in older men. During rapid eye movement (REM) sleep these

patients are reported to thrash limbs, may walk about, or engage in more complex activity. (102)

REMSBD can be difficult to distinguish from nocturnal frontal lobe seizures, which arise from sleep, and can present with violent movements, automatisms and vocalisations. However, REMSBD tends to occur in the second half of sleep, comparatively nocturnal frontal lobe seizures usually present in childhood, and can be of shorter duration. (103, 104)

The Frontal Lobe Epilepsies and Parasomnias (FLEP) scale is a series of questions aimed at reflecting the diagnostic features of nocturnal frontal lobe epilepsy (NFLE) and parasomnias. A total score of 1 or greater indicating a diagnosis of epilepsy and a score of zero or less indicating parasomnias. The FLEP score was shown to have good sensitivity of 1.0 (95% confidence interval [CI], 0.85-1.00) and specificity of 0.90 (95% CI, 0.73-0.97) when used to diagnose nocturnal frontal lobe epilepsy when compared to clinical diagnosis. (105)

Periodic leg movements and restless leg syndrome are other parasomnias that are common in older people, and these need to be considered in the differential diagnosis of nocturnal motor events. A sleep study with concurrent video-EEG monitoring might be required to distinguish epileptic seizures from sleep disorders in older people. (106)

1.3.3 Diagnostic evaluation

The interictal EEG can be of limited diagnostic value in older people due to high rates of non-specific abnormalities. A study of older people who underwent video-EEG monitoring, found that 26% of those with non-epileptic events had interictal epileptiform discharges as did 75% of those with epilepsy. (107)

Video-EEG can be useful if patients have frequent atypical events, and can in these situations help differentiate between epileptic and non-epileptic events. (108)

Patients with definite epilepsy or recurrent events of uncertain aetiology should undergo brain imaging to detect any underlying structural abnormalities. MRI is the preferred imaging modality. In older people, brain imaging may show evidence of previous cerebral infarction, or small vessel ischaemic change. However, the presence of these abnormalities does not necessarily infer that the event was an epileptic seizure. (109)

1.4 Pharmacological treatment

Age related changes in the body may lead to adjustments in dosage and drug selection in older people. (110) Changes in the pharmacodynamics and pharmacokinetics of AEDs in this population also depend on the effects of co-existing medication and comorbidities. (111)

Several physiological changes occur with ageing that can affect medication pharmacokinetics and may therefore lead to an increased risk of adverse effects. The absorption of drugs might be reduced in older people. A decrease in lean body mass, combined with a progressive reduction in hepatic and creatinine clearance have been observed with increasing age, resulting in higher serum AED concentrations than in younger adults. Therefore, lower doses of AEDs may need to be used in patients with moderate to severe renal failure. (112-114)

The binding of drugs to serum proteins can reduce with age due to decreased serum albumin levels. This results in an increased protein free fraction for drugs that are highly protein bound, such as phenytoin and sodium valproate. (115)

Ageing leads to a progressive decline in counter-regulatory homoeostatic mechanisms in the brain, making it a particularly sensitive pharmacological target. Therefore the rate of adverse events tends to be higher in older people, supporting the principle of starting AEDs at a low dose and titrating these slowly in this group. (116)

Co-existing comorbidities are very common in older patients and are an important consideration in the management of epilepsy in this population. Older individuals are often on multiple medications that can interfere with AEDs, or vice versa. Many older patients are receiving antihypertensives, antiarrhythmic agents, anticoagulants, diuretics, lipid lowering medication, and psychoactive medication at the time of diagnosis. The main interactions of concern are effects of drugs on protein binding and hepatic enzymes. Enzyme inducing antiepileptic medications can induce the metabolism of other concomitant medications. (112)

Phenytoin and carbamazepine can lower the serum concentration of simvastatin and reduce the efficacy of warfarin. (117) Phenytoin can also compete with coumadin for protein binding and can displace this drug, leading to increased concentration of free coumadin in the serum. (118)

Fluoxteine, an enzyme inhibitor can increase carbamazepine levels. (119) Herbal supplements taken by older people can add to the potential for interactions. Some herbal remedies affect cytochrome P450 enzyme systems. Other herbal remedies such as star anise and ginkgo biloba can increase the risk of seizures due to their intrinsic proconvulsant properties. (120, 121)

Various mechanisms have been suggested for the reduction of bone density in patients with epilepsy, one of these is enzyme-inducing AEDs accelerating vitamin D metabolism resulting in lowered levels of 25 hydroxy-vitamin D [25 (OH) D] and 1 alpha, 25 (OH) 2D. (122) Another proposed mechanism is that non enzyme-inducing AEDs may lead to hypocalcemia, stimulating parathyroid hormone release, with the aim of restoring serum calcium levels at the expense of bone calcium. (122)

Patients with epilepsy have a 2-6 times greater risk of bone fractures compared with the general population, in particular of the vertebral bodies and femoral neck. There are several potential explanations for this, including fractures caused by seizure-related injuries or associated with the osteopenic effect of reduced physical activity. (123-125)

The duration of AED treatment is associated with the rate of drug-induced bone loss. (126) Reduced bone mineral content is observed in 20–65% of patients with long-term use of AEDs. (127)

Enzyme-inducing AEDs are associated with an increased fracture risk. (128, 129) Phenytoin, an enzyme inducer has the greatest potential to affect bone and mineral metabolism. (130, 131) The data on carbamazepine, which is also an enzyme inducer, and sodium valproate, an enzyme inhibitor, are somewhat conflicting, but in some studies both drugs have been associated with osteopenia. (132, 133)

Drugs which inhibit carbonic anhydrase, such as topiramate and zonisamide, can have an unfavourable influence on bone metabolism by causing metabolic acidosis. (134) Data from animal studies show that levetiracetam reduces bone strength without altering bone mass. (135) There are no data on direct association between lamotrigine and fractures. (136)

A study assessing the effects of oxcarbazepine and levetiracetam monotherapy on the levels of calcium, ionized calcium, and vitamin D in epileptic patients, found that patients taking oxcarbazepine had lower calcium, ionized calcium, and vitamin D compared to controls. Patients taking levetiracetam however did not differ significantly from controls in terms of calcium, ionized calcium, and vitamin D levels. (137)

Healthy older people with epilepsy can be managed in a similar way to younger adults. Treatment decisions should be individualised. (138) Older individuals who are frail or have multiple comorbidities need to be treated with an AED that has a favourable side effect and tolerability profile. Those with multiple medical problems should be started on AEDs that do not interact with existing medication. Special consideration should also be given to nursing home residents who are receiving AEDs as they are often on five or six other routine medications. (139)

1.4.1 Clinical trials

Clinical trials assessing the management of epilepsy in the general population are also likely to be of relevance in older people. Older individuals are exposed to an increasing number of risk factors for seizures and epilepsy often due to pre-existing comorbidities such as stroke and AD. Focal epilepsy is therefore more likely in this group rather than genetic generalised epilepsy. (140)

Older studies into management of focal epilepsy concluded that carbamazepine was the most effective AED, making carbamazepine first line treatment for focal epilepsy. (141, 142) Subsequent trials comparing carbamazepine to lamotrigine found that the latter is better tolerated, with comparable rates of seizure freedom between the two. A substantial body of evidence supports the use of lamotrigine as first line therapy for focal onset epilepsy. (143-146)

The veterans' administration (VA) cooperative double blind, multicentre, randomized trial, compared carbamazepine, phenobarbital, phenytoin and primidone in 622 adult patients with partial epilepsy. Patients were followed up for 2 years or until the drug failed to control seizures or caused unacceptable adverse effects. Overall treatment success was highest with carbamazepine or phenytoin, intermediate with phenobarbital, and lowest with primidone ($p<0.002$). Carbamazepine and phenytoin were felt to be the AEDs of choice for single-drug therapy of adults with partial or generalized tonic-clonic seizures or with both. (141)

A second VA cooperative trial with a similar design compared carbamazepine and sodium valproate and found carbamazepine to be more effective for focal seizures. The two drugs were equally effective for secondary generalised tonic–clonic seizures. Carbamazepine had fewer long-term adverse effects than sodium valproate. (142)

Lamotrigine and carbamazepine were compared in a multicentre, double blind trial involving 150 older patients with newly diagnosed epilepsy. The two drugs were similar regarding efficacy measures, but the dropout rate due to adverse events

was much lower for patients treated with lamotrigine than those treated with carbamazepine. Furthermore, side effects of somnolence were less commonly observed with lamotrigine. (143)

A further VA cooperative trial compared lamotrigine and gabapentin to carbamazepine in a multi-centre, randomised, double blind, double dummy, parallel study of 593 older individuals with newly diagnosed seizures. The target doses were lamotrigine 150 mg per day, carbamazepine 600 mg per day and gabapentin 1,500 mg per day. The primary outcome measure was retention in the trial for 12 months. (146)

Early terminations occurred more often in the carbamazepine group than in the other two groups, mostly owing to adverse events (P = 0.0002). No significant differences were noted between groups with regards to seizure freedom at 12 months. The study concluded that lamotrigine or gabapentin should be considered as initial therapy for older patients with newly diagnosed seizures. (146)

These findings are not supported by further studies. Lamotrigine was better than both carbamazepine and gabapentin in a large, unblinded, randomized, controlled trial in focal epilepsy. This trial also showed that in terms of time to treatment failure, lamotrigine was superior to topiramate and had a non-significant advantage over oxcarbazepine. (144)

The studies described above all used immediate release carbamazepine which is not as well tolerated as the sustained release preparation. Therefore, the sustained release formulation might be a better comparator for trials in this population.

An international multicentre, randomized, double-blind, controlled trial of lamotrigine and sustained release carbamazepine in older individuals did not find significant differences in efficacy between these two drugs. However better tolerability with lamotrigine was observed. (145)

A randomised, open label controlled, parallel group, multicentre trial was conducted to test the superiority of levetiracetam over lamotrigine. The primary endpoint was the rate of seizure-free patients in the first 6 weeks. 409 patients were included with newly diagnosed focal or generalised epilepsy. There were no significant differences with regard to efficacy and tolerability of levetiracetam and lamotrigine in newly diagnosed focal and generalised epilepsy despite more rapid titration in the levetiracetam arm. (147)

Carbamazepine and phenytoin are strong enzyme inducers with potential for adverse interactions. The nonlinear kinetics of phenytoin might be particularly problematic in older individuals given that the phenytoin dose curve is much steeper in older than in younger adults. (148) Considerable variability in serum phenytoin concentrations has also been noted in older nursing home residents. (149)

The binding of phenytoin to serum proteins may decrease with age. If only total AED serum levels are considered in dose adjustments, continued titration can potentially lead to toxic effects at what may appear therapeutic total AED levels. This makes the dosage of phenytoin difficult to manage in older people and yet this drug has been shown to be widely prescribed for seizures in the nursing home setting. (150)

Carbamazepine is a potent inducer of cytochrome P450 enzymes and shows numerous interactions with other drugs. Carbamazepine can also lead to hyponatremia, which older patients are already susceptible to developing, thereby increasing the risk of this occurring. Carbamazepine and phenytoin are both associated with increased serum levels of cholesterol and c-reactive protein, which are markers of vascular risk. The levels of these markers decrease when patients are switched to lamotrigine or levetiracetam. (151)

Sodium valproate, whilst not an enzyme inducer, is highly protein bound. The protein free portion can increase in low protein states and in the presence of other

highly protein bound medications. A study evaluating the influence of ageing on the pharmacokinetics of sodium valproate at steady-state, and the susceptibility of sodium valproate metabolism to enzyme induction by other AEDs, showed that sodium valproate clearance in older patients receiving enzyme inducing AEDs was lower than in controls. The measurements of clearance were based on total serum sodium valproate concentrations. The difference was felt to be secondary to ageing as well as the fact that mean sodium valproate dosage was lower in these patients than in controls. (114)

Chronic sodium valproate treatment has also been associated with parkinsonism in older patients. (152) Sodium valproate can be considered with caution in older individuals if generalised epilepsy is suspected.

Oxcarbazepine has been studied extensively as first line monotherapy for focal epilepsy, however experience with this drug in older people is limited. Oxcarbazepine has been associated with hyponatremia in older individuals, particularly if administered with diuretics. Furthermore, hyponatremia was more common and more pronounced with oxcarbazepine than with carbamazepine. (153, 154) Oxcarbazepine could be a treatment option in healthy older people but should be considered with caution in older people who have multiple medical conditions.

A randomised comparison of low dose topiramate (50 mg/day) versus high dose (200 mg/day) in older people with focal onset seizures favoured the low-dose regimen. Efficacy was similar with the two dosages when topiramate was used as monotherapy, however the 200 mg dosage was more effective than 50 mg as adjunctive therapy, supporting results from a previous study. (155, 156)

Topiramate has an unfavourable cognitive profile in comparison with lamotrigine, and therefore should be used cautiously in older patients who may have co-existing cognitive impairment. Other common adverse events of topiramate include

dizziness, headache and drowsiness. (157) Given the side effect profile, topiramate requires slow titration in older individuals.

Levetiracetam has been shown to have equal efficacy and tolerability to controlled release carbamazepine. (158) A randomised controlled trial assessing the effectiveness of controlled-released carbamazepine to levetiracetam and lamotrigine in older patients with newly diagnosed focal epilepsy, showed that retention with levetiracetam was higher compared to controlled-release carbamazepine due to better tolerability. Retention of lamotrigine was intermediate and close to levetiracetam. (159)

A small retrospective study suggested that levetiracetam monotherapy can be effective in older patients with newly diagnosed epilepsy, who were not on any AEDs, as well as in older patients with epilepsy. (160)

A Cochrane review of monotherapy in epilepsy concluded that levetiracetam may be a suitable alternative to carbamazepine and lamotrigine as first-line treatment for individuals with focal onset seizures.(161)

Levetiracetam clearance declines significantly with ageing, and older patients may require between 30% and 50% lower doses, compared to their younger counterparts to achieve a given levetiracetam plasma concentration. (162)

Zonisamide is a newer anti-epileptic drug licensed for use in focal epilepsy. The pharmacokinetic profile of zonisamide, lack of induction or inhibition of hepatic enzymes and mild interactions with other drugs, makes it favourable for the management of epilepsy in older people. (163, 164)

1.4.2 Anti-epileptic drug choice

Older people who have more than one unprovoked seizure should be started on anti-epileptic medication. Treatment of a first unprovoked seizure reduces the risk of a subsequent seizure. It does not however, affect the proportion of patients in long-term remission. Antiepileptic drugs are associated with adverse events, and there is no evidence that they reduce mortality. Therefore, the decision to start antiepileptic drug treatment following a first unprovoked seizure should be individualized and based on patient preference, clinical, cultural and social factors. (165)

There is no indication for the long-term prophylactic use of antiepileptic drugs in older patients who have been diagnosed with brain tumours or severe traumatic brain injury. (166, 167)

Older patients are more likely to develop focal epilepsy, however non-epileptic attacks can also present in this age group and should be considered in the differential diagnosis. (168, 169) The majority of older patients with epilepsy become seizure free on AED monotherapy at moderate dosage. (170) Focal epilepsy is more likely to be refractory to treatment and there is evidence that sodium valproate is not the best first AED to achieve seizure freedom. (144, 146, 171)

As outlined sodium valproate has also been implicated in reduction of bone density and increased risk of fractures in this group. (129, 172, 173) The continued use of sodium valproate for older patients with newly diagnosed epilepsy reflects outdated practice and is likely to be a consequence of management of these patients in primary care or by non-specialist services.

To date only five randomised controlled trials of AED monotherapy in older people with newly diagnosed epilepsy have been carried out. (143, 145, 146, 159, 174) Four of the trials have shown comparable efficacy, in terms of time to first seizure, or seizure freedom between carbamazepine and lamotrigine. (143, 145, 146, 174)

Retention rates were higher for lamotrigine than carbamazepine in these trials, mainly due to better tolerability with lamotrigine. (159)

There are no recognised differences in efficacy among all the available drugs for the treatment of newly diagnosed epilepsy, therefore choice will depend on the side-effect profile and tolerability. (158, 175) Typically if the first drug is not tolerated then a second drug should be tried, ideally with a different mechanism of action compared to the first one. (176) Toxicity in older patients may present at a lower dose.

Older people are more likely than their younger counterparts to develop idiosyncratic skin reactions with AEDs, particularly with phenobarbital, phenytoin, carbamazepine, lamotrigine, oxcarbazepine, and zonisamide. (177)

Surgical treatment for refractory epilepsy can be considered in older people however the complication rates are higher. (178)

1.5 Psychosocial factors

The consequences of epilepsy are as important to older people as they are their younger cohorts. Older adults are more likely to experience isolation. It is estimated that 17% of older adults are in contact with their family, friends, and neighbours less than once a week, and half of all people aged 75 and over live alone. (179)

Older adults diagnosed with epilepsy post-retirement age were more likely than those diagnosed pre-retirement to be both mildly anxious and mildly or moderately depressed, though the differences were not statistically significant. (180)

These findings were supported by a further study which showed that mean health questionnaire depression scores were higher for patients with epilepsy than controls with no diagnosis, indicating more depressive symptoms in patients with

epilepsy (4.2 vs. 0.8; p=0.006). Mean patient health anxiety scores were also higher for older patients with epilepsy than controls (3.7 vs. 0.0; p=0.001). (181)

Infrequent seizures can impair quality of life suggesting that in older adults the apprehension induced by the possibility of a further seizure may be enough to reduce health-related quality of life. A greater perception of stigma and more frequent seizures was also strongly related to poor quality of life and reduced psychosocial function. (182)

Furthermore, isolation from loss of driving, restriction in employment, social embarrassment from seizures and safety are major concerns expressed by older patients who have seizures. Medication side effects also appear to be of concern. (183)

1.6 Aims

One of the main aims of this project was to assess differences in care provided to patients with seizures and epilepsy, comparing those aged 60 and over to those under 60.

High rates of CT head imaging, in patients with epilepsy, were noted in NASH2 however it was beyond the scope of NASH2 to explore this further. As part of the two audits, older patients with epilepsy who had CT head imaging had their reports reviewed aiming to assess the yield of this investigation.

Referral to specialist services in NASH2, was kept as broad as possible, however NASH2 was not set up to review referral patterns in older people. The two local audits aimed to ascertain whether there had been any change to referral rate of older patients with seizures presenting to ED, and if referred which speciality this was to.

Chapter 2. Methods

2.1 National Audit of Seizure Management in Hospital 2

This study presents data from the National Audit of Seizure management in Hospitals (NASH2). (184) NASH2 collated data on patients presenting with seizures to EDs, and assessed the care they received prior to admission, management of the acute event and follow-up arrangements.

2.1.1 Site selection and recruitment

NASH2 was coordinated from the University of Liverpool and overseen by a multidisciplinary steering committee consisting of representatives from neurology, emergency medicine, primary care, a patient charity, Information Systems and statistics.

Letters to the Chief Executives and Heads of Clinical Audit, and emails to participants from NASH2, were sent in February 2013 to all Trusts/Health Boards in England, Scotland, Wales and Northern Ireland which had sites with EDs, representing 165 UK trusts. 132 trusts participated, with some Trusts having more than one site take part, resulting in data collection from 154 sites.

Each site was asked to identify up to 30 consecutive adult patients who presented at the ED from 1st January 2013 with an episode thought to have been a seizure (the following International Classification of Diseases 10 (ICD10) codes were used as an indication of potential seizure: G40.0, G40.1, G40.2, G40.3, G40.4, G40.5, G40.6, G40.7, G40.8, G40.9, G41.0. G41.1, G41.2, G41.8, G41.9, R56.1 and R56.8), and where the seizure was the primary reason for their admission/attendance.

Patients presenting to ED, who were either admitted or discharged were selected, providing an index point and opportunity to identify first seizure, new epilepsy cases as well as established cases with uncontrolled seizures.

2.1.2 Data collection

The proforma captured the clinical care pathway for individual patients. The questions were based on the NICE and SIGN guidelines (4, 185) augmented by the practical experience of the steering committee. The clinical proforma was divided into sections covering the care antecedent to the presenting seizure, the care at hospital (in the ED and on medical wards) and the future plans for the patient. Recognising the constraints on data collectors, a limited range of items was collected.

The two proformas were piloted, with duplicate collections from 60 patients across 10 sites, and the questions amended and refined to reduce ambiguities and inconsistencies. (Appendix 1)

Data was entered anonymously into a bespoke web-based audit system. Online help was available for the majority of questions. Data entry took place from June to September 2013, when follow up information should have been available. If an individual attended more than once, each attendance was treated as a separate event.

Initial diagnosis and management were carried out by medical staff in ED, with onward referral and admission to hospital as clinically indicated. The following investigations were documented: AED levels, computed tomography (CT) head, electrocardiogram (ECG), electroencephalogram (EEG), glucose levels and magnetic resonance imaging (MRI) head.

In keeping with other published data, patients aged 60 and over were selected from the NASH2 data set. In order to assess whether there was a difference in patient management according to age, management of patients aged 60 and over was compared to those under 60.

Results are shown as the percentage for all patients. Statistical analysis was carried out using Chi-square test, with 95% confidence interval. Analysis was carried out with GraphPad Prism.

2.1.3 Terminology

Review by senior – evidence of review by senior doctor in ED, deemed to be speciality or consultant grade.

Eyewitnesses account – either collateral history from person attending with patient in ED or separate contact for collateral history.

Documentation of alcohol intake – DoH guidance recommends alcohol use should be documented in all, and especially where it is a known provoking factor for the event.

Care plan – This is a NICE quality statement, patients with epilepsy should have a written care plan in place. (4) What this constituted was open to interpretation by local auditors.

Recording of data – recording temperature, and recording GCS, should be routine practice.

Neurological examination –a full neurological examination including plantar reflex and fundi examination.

Specialist review – was kept as broad as possible and included, general practitioner with specialist interest in epilepsy (GPSI), learning disability psychiatrist, neurologist, epilepsy nurse specialist, alcohol and drug liaison service or neurosurgeon.

2.2 Audits - University Hospital Aintree and Royal Liverpool University Hospital

Two retrospective case note audits were carried out reviewing the care of all patients aged 60 and over, attending University Hospital Aintree (UHA) and Royal Liverpool University Hospital (RLH) ED, from December 2014 to June 2015, with an episode thought to have been a seizure and where this was the primary reason for admission or attendance. If an individual attended more than once, each attendance was treated as a separate episode.

Patients fulfilling the criteria for analysis were identified by the local audit departments. The same clinical questions used in NASH2 were also used for the purposes of these audits. Additional information on previous medical conditions was also collected. (Appendix 2)

The outcome measures used in NASH2 have been used for these audits, aiming to assess care prior, during, and after ED attendance.

Patients with epilepsy who had CT imaging had their reports reviewed. These were then subdivided into patients whose CT imaging showed no new abnormalities or acute changes, and those where a new abnormality or acute change was noted. With regards to abnormal findings these were deemed to be findings which would alter acute patient management, such as stroke or intracerebral haemorrhage.

With regards to onward referral to specialist services these audits aimed to collect data of referral to any speciality, not just neurology, for older patients attending ED with seizure. In line with NASH2, results are shown as percentages for all patients.

Chapter 3. Results

3.1 Results - National Audit of Seizure Management in Hospitals 2

3.1.1 NASH 2 - Statistical analysis

For the purposes of analysis patients in NASH2 were divided into the following categories:

1. Those recorded as having known epilepsy prior to attendance. 60 and over (n=640; 51%) under 60 (n=2115; 65%).
2. Those known to have had previous seizures or blackouts, but not a diagnosis of epilepsy. 60 and over (n=209; 17%) under 60 (n=556, 17%).
3. Those with likely first seizure, with no previous seizures, blackouts or diagnosis of epilepsy. 60 and over (n= 405; 32%) under 60 (n=606, 18%).

3.1.2 NASH 2 - Patient characteristics

Of the total 4531 patients, 1256 (28%) were aged 60 years and over and included for analysis (median age 74 years, IQR 66-82, 54% men). 87% (1088/1256) of the clinical information was entered by doctors, 8% (104/1256) by nurses, 5% (64/1256) by audit staff or other healthcare professionals. 2 patients could not be classified with regards to diagnosis and were excluded from analysis.

3.1.3 NASH 2 - Treatment prior to admission

In the known epilepsy group 44% (281/640) had presented to ED with a seizure in the preceding 12 months as did 41% (85/209) of patients with previous seizure or blackout.

In patients with known epilepsy 86% (552/640) were documented as taking AED treatment. 59% (377/640) were on monotherapy, 27% (175/640) were on two or more AEDs (i.e. polytherapy). (Table 1, Figure 1)

Sodium valproate was the most commonly used AED both as monotherapy 28% (181/640) and polytherapy 42% (267/640). 9% (56/640) of patients with epilepsy were on carbamazepine monotherapy, 8% (50/640) phenytoin monotherapy, 9% (40/640) lamotrigine monotherapy and 9% (39/640) on levetiracetam monotherapy.

In those aged 60 and over with epilepsy 28% percent (179/640) had evidence of contact with an epilepsy specialist recorded in the year preceding their attendance, compared to 40% (842/2115) of patients under 60. Only 30% (189/640) of patients aged 60 and over with epilepsy had a written care plan in place.

Figure 1. Number of anti-epileptic drugs by diagnosis

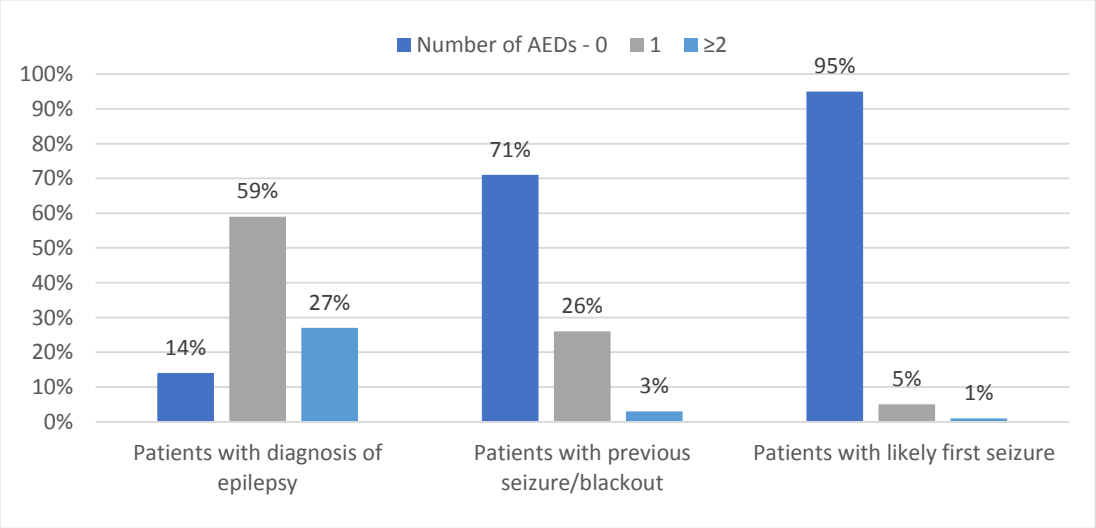


Table 1. Anti-epileptic drug treatment and review prior to presentation – Patients aged 60 and over and under 60

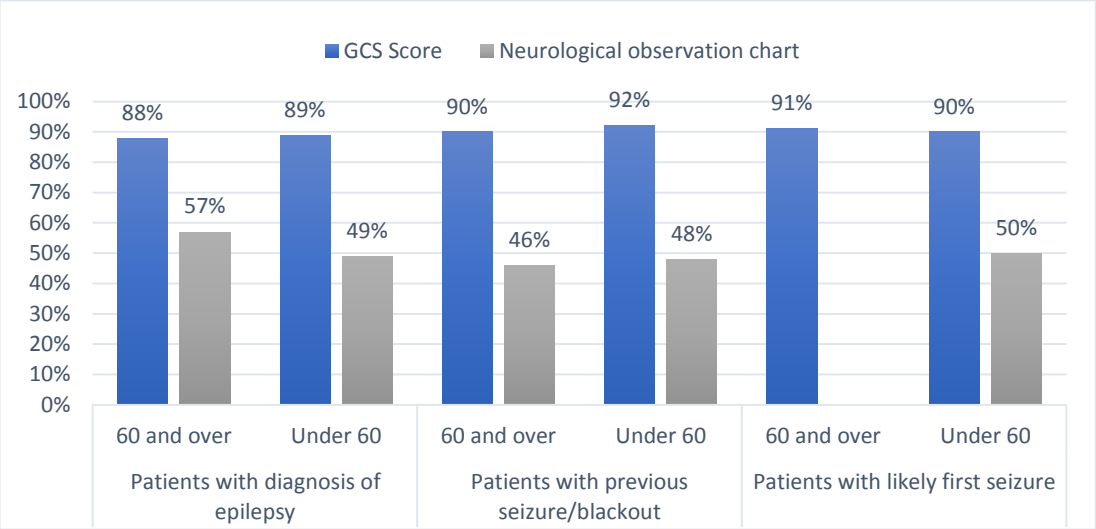
	Patients with diagnosis of epilepsy		Patients with previous seizure/blackout		Patients with likely first seizure	
	60 and over % (n=640)	Under 60 % (n=2115)	60 and over % (n=209)	Under 60 % (n=556)	60 and over% (n=405)	Under 60 % (n=606)
No AEDs	14% (88)	19% (410)	71% (148)	84% (466)	95% (383)	95% (577)
Monotherapy	59% (377)	45% (950)	26% (55)	14% (78)	5% (19)	4% (26)
Two or more AEDs	27% (175)	36% (755)	3% (6)	2% (12)	1% (3)	0% (3)
Specialist review in the past 12 months	28% (179)	40% (842)	25% (52)	32% (176)	7% (27)	2% (43)

AEDs – Anti-epileptic drugs.

3.1.4 NASH 2 - Assessment on arrival

The majority of patients had their GCS and temperature checked on arrival to ED. The figures were similar for those over and under 60. 57% (364/640) of patients with epilepsy had a neurological observation chart in place within 4 hours of arrival. 46% (97/209) of patients with previous seizure or blackout had a neurological observation chart started. In those presenting with a likely first seizure aged 60 and over, only 2 of 405 patients had a neurological observation chart started, compared to 50% (303/606) of patients under 60 presenting with a likely first seizure. (Table 2, Figure 2)

Figure 2. GCS and neurological observation chart in patients aged 60 and over compared to under 60



In patients presenting with a likely first seizure 43% (175/405) had plantar reflexes checked. Fundoscopy was only carried out in 15% (60/405).

For those presenting with a likely first seizure, an eyewitness account was sought in 80% (323/405) of patients over 60 compared to 72% (436/606) in patients under 60.

Senior review or discussion with a senior in ED was carried out in 57% (229/405) of patients presenting with a likely first seizure and in 59% (377/640) of patients with epilepsy. These figures were comparable to those in the under 60s. (Table 2)

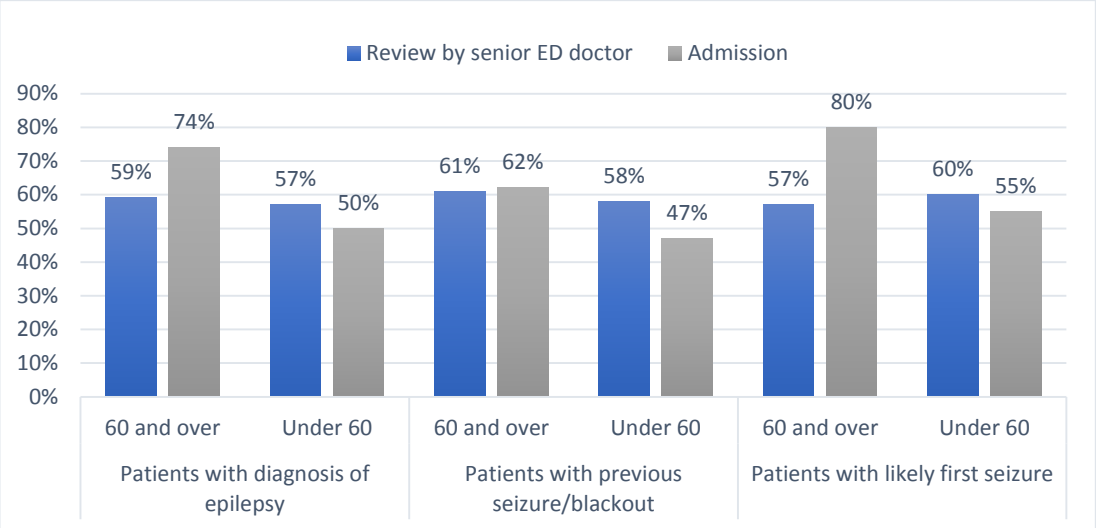
Table 2. Assessment on arrival to emergency department – Patients aged 60 and over and under 60

	Patients with diagnosis of epilepsy		Patients with previous seizure/blackout		Patients with likely first seizure	
	60 and over % (n=640)	Under 60 % (n=2115)	60 and over % (n=209)	Under 60 % (n=556)	60 and over % (n=405)	Under 60 % (n=606)
GCS Score	88% (561)	89% (1892)	90% (189)	92% (514)	91% (369)	90% (544)
Neuro obs chart	57% (364)	49% (1026)	46% (97)	48% (266)	0% (2)	50% (303)
Temperature	92% (587)	92% (1953)	94% (198)	94% (520)	90% (367)	92% (557)
Fundoscopy	12% (74)	13% (272)	17% (35)	15% (84)	15% (60)	21% (127)
Plantar reflex	33% (213)	29% (615)	40% (85)	34% (190)	43% (175)	41% (247)
Eyewitness account	73% (464)	64% (1361)	81% (170)	65% (360)	80% (323)	72% (436)
Review by senior ED doctor	59% (377)	57% (1206)	61% (127)	58% (325)	57% (229)	60% (363)
Documented alcohol intake	27% (174)	40% (851)	42% (87)	59% (326)	31% (126)	59% (359)
Admission	74% (474)	50% (1065)	62% (131)	47% (263)	80% (326)	55% (331)

ED – accident and emergency department; Neuro obs – Neurological observation chart.

Rates of admission were higher in patients aged 60 and over compared to those under 60. (Table 2, Figure 3)

Figure 3. Admission to hospital and senior review in ED in patients aged 60 and over compared to under 60



In patients aged 60 and over presenting with a likely first seizure 80% (326/405) were admitted to hospital, compared to 55% (331/606) of those under 60 ($p<0.001$). 74% (474/640) of patients aged 60 and over with epilepsy presenting with a seizure were admitted to hospital, compared to 50% (1065/2115) of those under 60 ($p<0.001$).

Documentation of alcohol intake was lower for patients aged 60 and over presenting with a likely first seizure and was carried out in 31% (126/405), compared to 59% (359/606) of those under 60.

3.1.5 NASH2 - Inpatient management

ECG, a NICE guideline-recommended investigation, was documented in 91% (370/405) of patients aged 60 and over presenting with a likely first seizure and in 83% (534/640) of those aged 60 and over with known epilepsy. (17) (Table 3)

Advice or review by neurology during admission was low across the board when compared between patients aged 60 and those under 60.

CT head imaging was the primary imaging modality, with only 3-4% of patients aged 60 and over having MRI. 71% (290/405) of patients aged 60 and over with a likely first seizure had a CT scan on admission, compared to 43% (259/606) of those under 60 ($p<0.001$)

In those aged 60 and over with epilepsy 35% (226/640) had a CT scan during admission compared to only 17% (369/2115) of those under 60 ($p<0.001$). (Table 3, Figure 4)

Figure 4. CT head in patients aged 60 and over compared to under 60

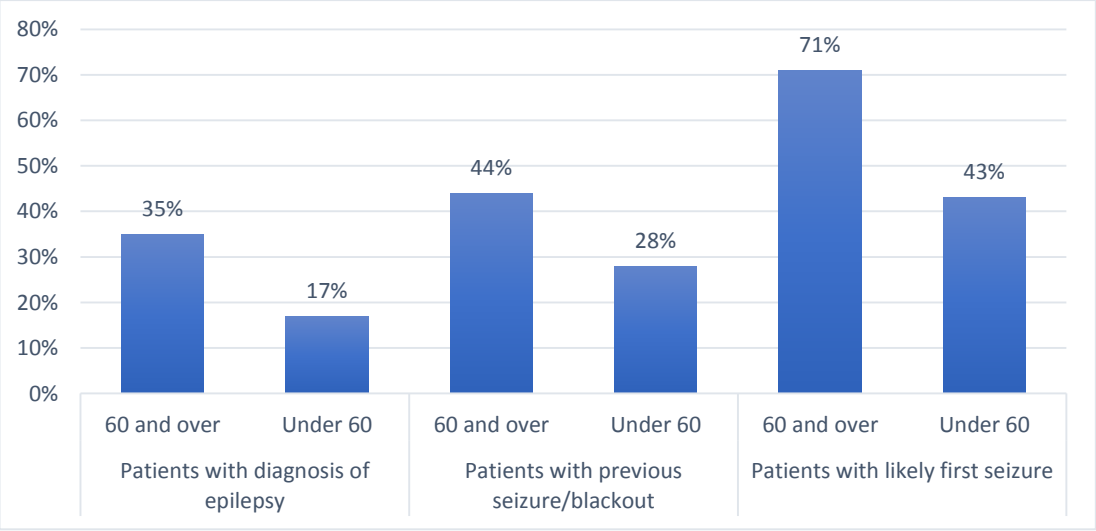


Table 3. Assessment and review during admission – Patients aged 60 and over and under 60

	Patients with diagnosis of epilepsy		Patients with previous seizure/blackout		Patients with likely first seizure	
	60 and over % (n=640)	Under 60 % (n=2115)	60 and over % (n=209)	Under 60 % (n=556)	60 and over % (n=405)	Under 60 % (n=606)
CT	35% (226)	17% (369)	44% (91)	28% (153)	71% (290)	43% (259)
CT GCS 3-8	44% (31/70)	46% (49/107)	65% (13/20)	25% (3/12)	87% (45/52)	81% (13/16)
CT GCS 9-12	45% (43/95)	27% (43/162)	38% (8/21)	48% (14/29)	73% (29/40)	63% (19/30)
CT GCS 13-15	32% (128/396)	15% (249/1621)	43% (63/148)	27% (128/472)	69% (192/277)	42% (207/496)
MRI	3% (17)	2% (41)	4% (8)	3% (17)	8% (33)	7% (43)
ECG	83% (534)	64% (1359)	86% (180)	77% (427)	91% (370)	84% (508)
Glucose	86% (550)	80% (1696)	86% (180)	82% (456)	87% (352)	86% (523)
Advice or review by neurology	22% (143)	21% (435)	20% (42)	18% (100)	21% (87)	17% (101)

CT – Computed tomography

32% (128/396) of patients aged 60 and over with known epilepsy, and GCS of 13-15 on admission, went on to have a CT. This figure is much higher than for those under 60 where only 15% (249/1621) with a GCS of 13-15 went on to have a CT. (Figure 5)

The number of CTs carried out did not differ between age groups, bar those aged over 90 where the rate of CTs carried out was significantly lower. (Table 4, Figure 6)

Figure 5. CT head stratified by GCS score in patients aged 60 and over compared to under 60

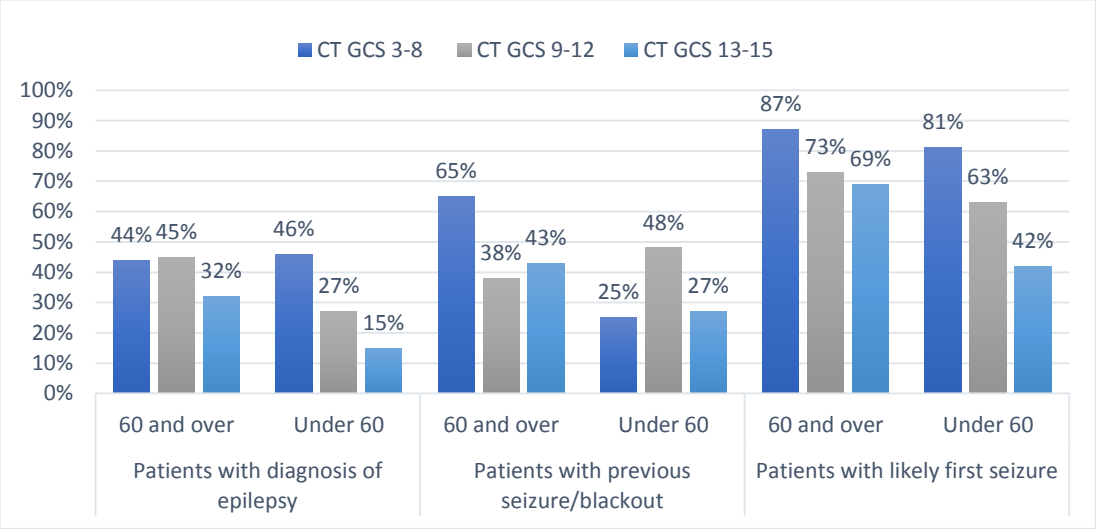


Figure 6. CT head stratified by age group and diagnosis

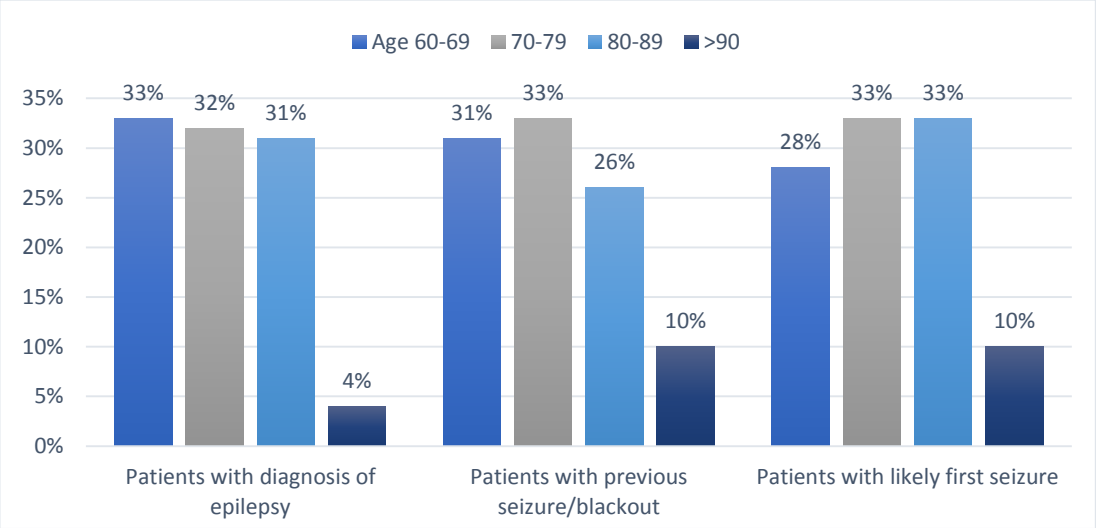


Table 4. CT head by age group and diagnosis

Age	Patients with diagnosis of epilepsy % (n=226)	Patient with previous seizure/blackout % (n=91)	Patients with likely first seizure % (n=290)
60-69	33% (75)	31% (28)	28% (81)
70-79	32% (72)	33% (30)	33% (95)
80-89	31% (70)	26% (24)	33% (86)
>90	4% (9)	10% (9)	10% (28)

3.1.6 NASH2 - Care following admission

Patients who died during admission were excluded from analysis of follow-up arrangements

1. Those recorded as having known epilepsy prior to attendance. 60 and over (n=622), under 60 (n=2114).
2. Those known to have had previous seizures or blackouts, but not a diagnosis of epilepsy. 60 and over (n=208), under 60 (n=554).
3. Those with likely first seizure, with no previous seizures, blackouts or diagnosis of epilepsy. 60 and over (n= 390), under 60 (n=603).

Seizure was quoted as the cause of death in only one patient with known epilepsy (1/18) and in one presenting with likely first seizure (1/15).

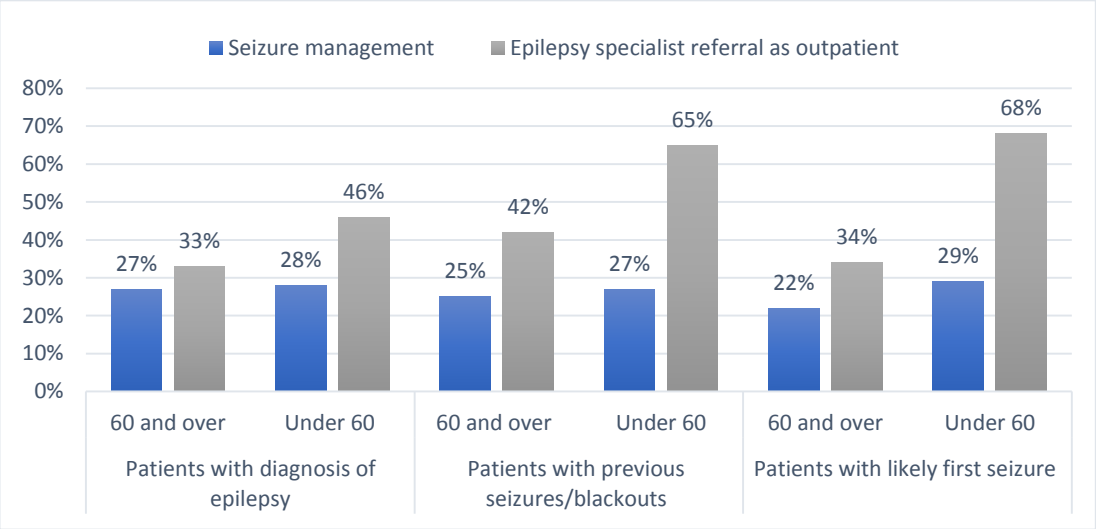
Only 22% (90/390) of patients aged 60 and over presenting with a likely first seizure were given advice on what to do should they go on to have further seizures, compared to 29% (175/603) of those aged under 60. (Table 5)

Table 5. Seizure management and specialist referral - Patients aged 60 and over and under 60

	Patients with diagnosis of epilepsy		Patients with previous seizures/blackouts		Patients with likely first seizure	
	60 and over % (n=622)	Under 60 % (n=2114)	60 and over % (n=208)	Under 60 % (n=554)	60 and over % (n=390)	Under 60 % (n=603)
Seizure management	27% (172)	28% (592)	25% (53)	27% (150)	22% (90)	29% (175)
Epilepsy specialist referral as outpatient	33% (206)	46% (982)	42% (87)	65% (360)	34% (131)	68% (411)

34% (131/390) of patients aged 60 and over, presenting with a likely first seizure were referred by ED, or asked to be referred by their GP, for an epilepsy outpatient review compared to 68% (411/603) of those under 60. (Figure 7)

Figure 7. Seizure management and specialist referral in patients aged 60 and over and under 60



There was a downward trend in referral rate by age group. 42% (105/252) of 60-69 year olds with epilepsy were referred on discharge compared to 24% (35/157) of those 80-89. 52% (57/110) of 60-69 year olds presenting with a likely first seizure were referred compared to 25% (29/116) of patients aged 80-89. (Table 6, Figure 8)

In patients with epilepsy aged 60 and over 33% (206/622) were referred to a specialist on discharge compared to 46% (982/2114) of those aged 60 and under ($p<0.001$). 34% (131/390) of patients aged 60 and over and 68% (411/603) aged under 60 with a likely first seizure were referred to a specialist on discharge ($p<0.001$).

53% (94/176) of patients aged 60 and over with epilepsy, who had contact with neurology services in the preceding 12 months, were referred to epilepsy services on discharge, compared to 25% (112/445) of patients with epilepsy who had not been seen.

Figure 8. Referral to specialist services by age group

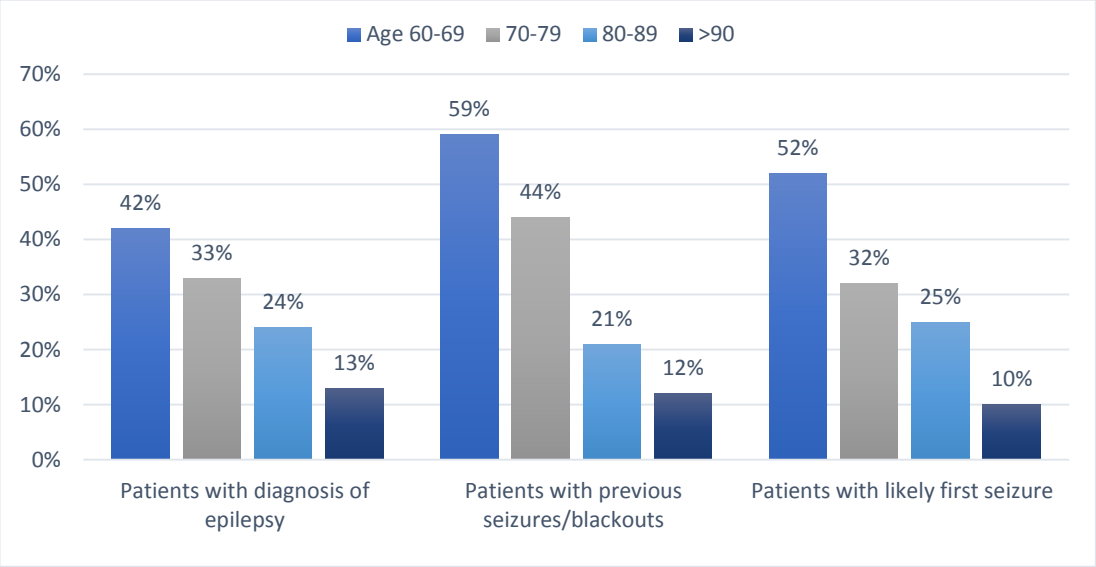


Table 6. Seizure management and specialist referral by age group

	Patients with diagnosis of epilepsy % (n=622)	Patient with previous seizures/blackouts % (n=208)	Patients with likely first seizure % (n=390)
Seizure management by age group			
60-69	28% (71/252)	21% (16/76)	20% (22/110)
70-79	29% (55/189)	25% (17/67)	23% (30/130)
80-89	26% (41/157)	30% (14/47)	25% (29/116)
> 90	22% (5/23)	35% (6/17)	30% (9/30)
Specialist referral by age group			
60-69	42% (105/252)	59% (45/76)	52% (57/110)
70-79	33% (62/189)	44% (30/68)	32% (42/130)
80-89	24% (37/157)	21% (10/47)	25% (29/116)
>90	13% (3/23)	12% (2/17)	10% (3/30)

3.2 Results - Audit University Hospital Aintree

121 patients were identified. Of these 11 had been coded incorrectly and had not had seizures. Analysis was carried out on the remaining 110 patients (median age 72, IQR 66-80, 45% male).

For the purposes of analysis patients were divided into the following three categories:

1. Those recorded as having known epilepsy, prior to attendance (n=58, 53%)
2. Those known to have had previous seizures or blackouts, but not a diagnosis of epilepsy (n=12, 11%)
3. Those with likely first seizures, no previous seizures or blackouts or diagnosis of epilepsy (n=40, 36%)

3.2.1 UHA - Treatment prior to admission

In patients with known epilepsy 66% (38/58) had presented to ED with a seizure in the preceding 12 months, as did 67% (8/12) of patients with a previous seizure or blackout. None of the patients presenting with a likely first seizure had attended ED in the preceding 12 months.

Amongst those with known epilepsy 38% (22/58) had a history of stroke. 13% (5/40) of patients presenting with a likely first seizure had previously had a stroke. 19% (11/58) of patients with epilepsy had a diagnosis of dementia compared to 28% (11/40) of patients presenting with a likely new seizure.

Two or more comorbidities were found in 38% (15/40) of patients presenting with a likely first seizure. In patients with known epilepsy 50% (29/58) had one comorbidity and 33% (19/58) had two. (Table 7, Figure 9)

Figure 9. Number of comorbidities by diagnosis

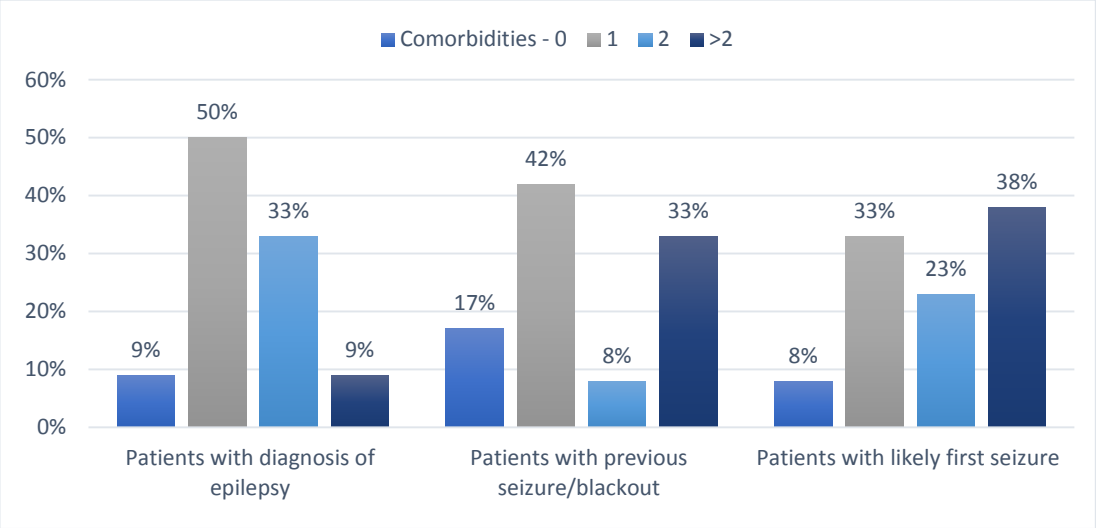


Table 7. Number of comorbidities by diagnosis

Number of comorbidities	Patients with diagnosis of epilepsy % (n= 58)	Patients with previous seizure/blackout % (n= 12)	Patients with likely first seizure % (n= 40)
0	9% (5)	17% (2)	8% (3)
1	50% (29)	42% (5)	33% (13)
2	33% (19)	8% (1)	23% (9)
>2	9% (5)	33% (4)	38% (15)

Amongst patients with known epilepsy 97% (56/58) were on AED treatment. 66% (38/58) were on monotherapy, 31% (18/58) were on two or more AEDs or polytherapy. Sodium valproate was the most commonly used AED, 45% (26/58) polytherapy, 40% (23/58) monotherapy. Of those with known epilepsy 9% (5/58) were on carbamazepine monotherapy and 9% (5/58) on levetiracetam monotherapy. (Table 8, Figure 10)

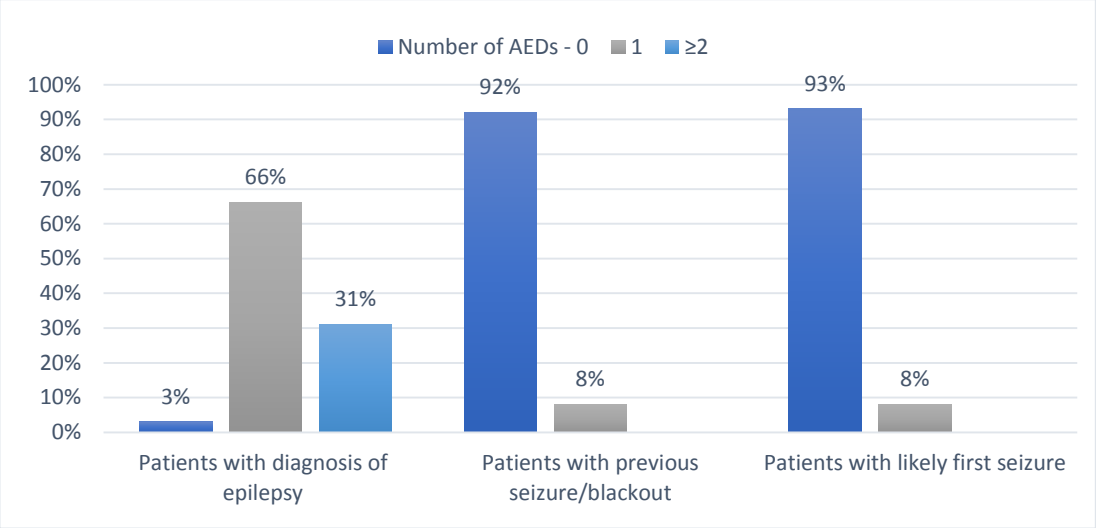
Of those with known epilepsy 36% (21/58) had been reviewed by an epilepsy specialist or neurologist in the preceding year. None of the patients with known epilepsy had a care plan in place.

Table 8. Anti-epileptic drug treatment and review prior to presentation

	Patients with diagnosis of epilepsy % (n= 58)	Patients with previous seizure/blackout % (n= 12)	Patients with likely first seizure % (n= 40)
No AEDs	3% (2)	92% (11)	93% (37)
Monotherapy	66% (38)	8% (1)	8% (3)
Two or more AEDs	31% (18)	0% (0)	0% (0)
Specialist review previous 12 months	36% (21)	17% (2)	8% (3)

AED, anti-epileptic drug.

Figure 10. Number of anti-epileptic drugs by diagnosis



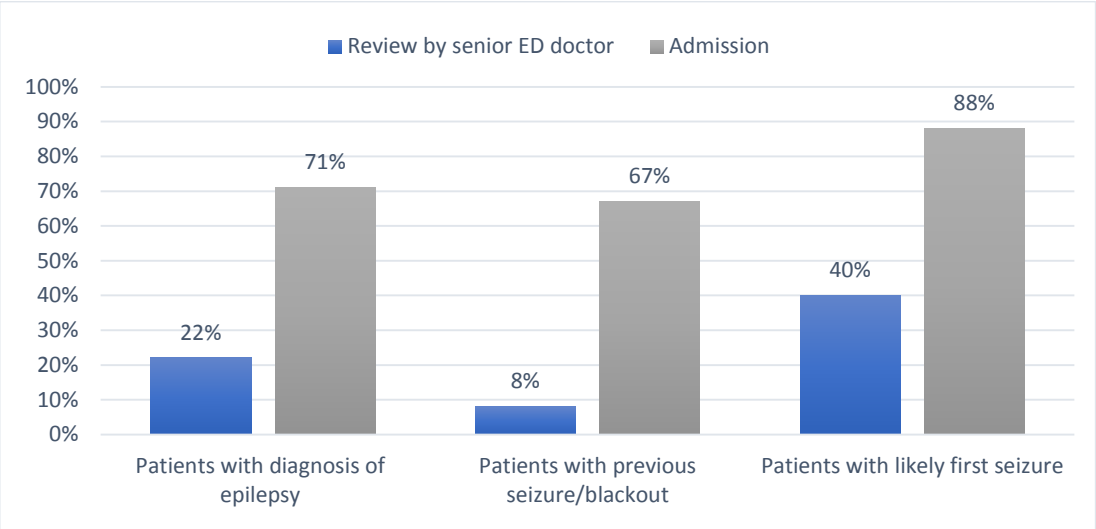
3.2.2 UHA - Assessment on arrival

GCS was checked on arrival in 95% (104/110) of all patients. All patients had their temperature, checked on arrival. 28% (16/58) of patients with known epilepsy had a neurological examination, as well as 20% (8/40) of patients presenting with a likely first seizure. None of the patients had examination of the fundi.

An eyewitness account was sought in 83% (33/40) of patients presenting with a likely first seizure and 88% (51/58) of patients with known epilepsy.

Senior review or discussion with a senior in ED within 4 hours of admission was carried out in 40% (16/40) of patients presenting with a likely first seizure. 22% (13/58) of patients with known epilepsy and 8% (1/12) of patients with previous blackouts were reviewed or discussed. (Figure 11)

Figure 11. Admission to hospital and senior review in emergency department



Only 5% (3/58) of patients with epilepsy were asked regarding alcohol intake. 30% (12/40) of patients presenting with a likely first seizure were asked regarding alcohol consumption as were 50% (6/12) of those with previous seizures or blackouts.

Admission to hospital was carried out in 71% (41/58) of patients with known epilepsy. 88% (35/40) of those with a likely first seizure were also admitted as were 67% (8/12) patients with previous seizures or blackouts. (Table 9)

Table 9. Assessments on arrival to emergency department

	Patients with diagnosis of epilepsy % (n=58)	Patients with previous seizure/blackout % (n=12)	Patients with likely first seizure % (n=40)
GCS score	95% (55)	100% (12)	93% (37)
Neurological exam	28% (16)	17% (2)	20% (8)
Eyewitness account	88% (51)	75% (9)	83% (33)
Review by senior ED doctor	22% (13)	8% (1)	40% (16)
Documented alcohol intake	5% (3)	50% (6)	30% (12)
Admission	71% (41)	67% (8)	88% (35)

GCS, Glasgow coma scale; ED, Emergency department.

3.2.3 UHA - Inpatient management

ECG on admission was carried out in 95% (105/110), regardless of diagnosis. 11% (6/56) of patients with epilepsy taking AEDs had their drug levels checked98% (108/110) had their glucose levels checked. Only 19% (11/58) of patients with epilepsy had review or discussion with neurology during admission.

Computed tomography (CT) was the primary imaging modality, only 6% (7/110) of patients had an MRI scan on admission. 83% (33/40) of patients with a likely first seizure had a CT head on admission. 50% (29/58) of patients with known epilepsy and 33% (4/12) of patients with previous seizure or blackout also underwent imaging.

In those with known epilepsy who had a GCS of 13-15, 52% (15/29) had CT head imaging. 64% (21/33) of patients presenting with a likely first seizure with a GCS of 13-15 had a CT. (Table 10, Figure 12)

Figure 12. CT head stratified by GCS score and diagnosis

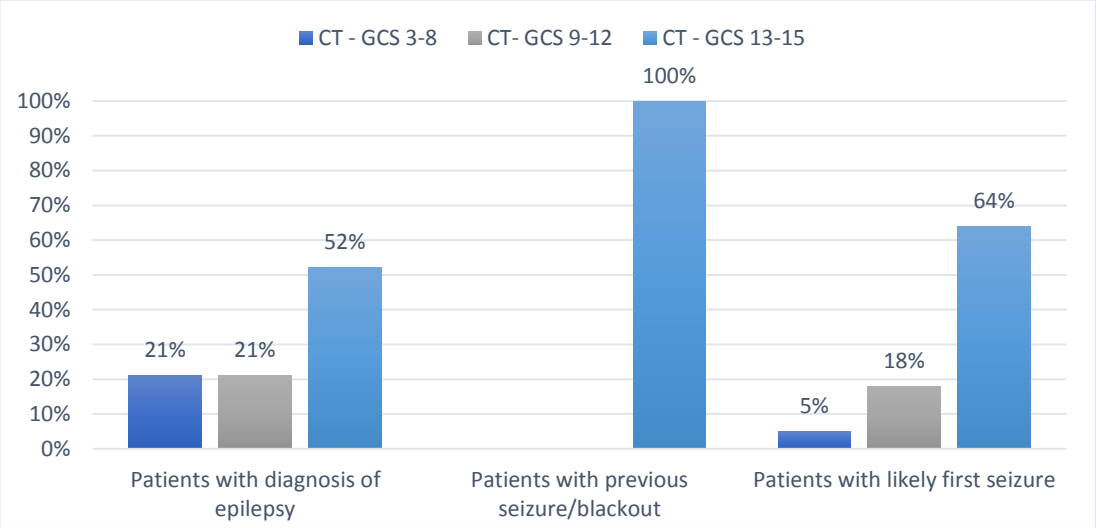


Table 10. Assessment and review during admission

	Patients with diagnosis of epilepsy % (n=58)	Patients with previous seizure/blackout % (n=12)	Patient with likely first seizure % (n=40)
CT	50% (29)	33% (4)	83% (33)
CT - GCS 3-8	21% (6)	0% (0)	15% (5)
CT- GCS 9-12	21% (6)	0% (0)	18% (6)
CT - GCS 13-15	52% (15)	100% (4)	64% (21)
CT – GCS unknown	7% (2)	0% (0)	3% (1)
ECG	93% (54)	100% (12)	98% (39)
Advice or review by neurology during admission	19% (11)	8% (1)	15% (6)

CT, computed tomography. ECG, electrocardiogram.

In those presenting with a likely first seizure aged 60-69, 36% (12/33) had a CT as did 30% (10/33) of 70-79 year olds and 30% (10/33) of 80-89 year olds. (Table 11, Figure 13)

Figure 13. CT head stratified by age group and diagnosis

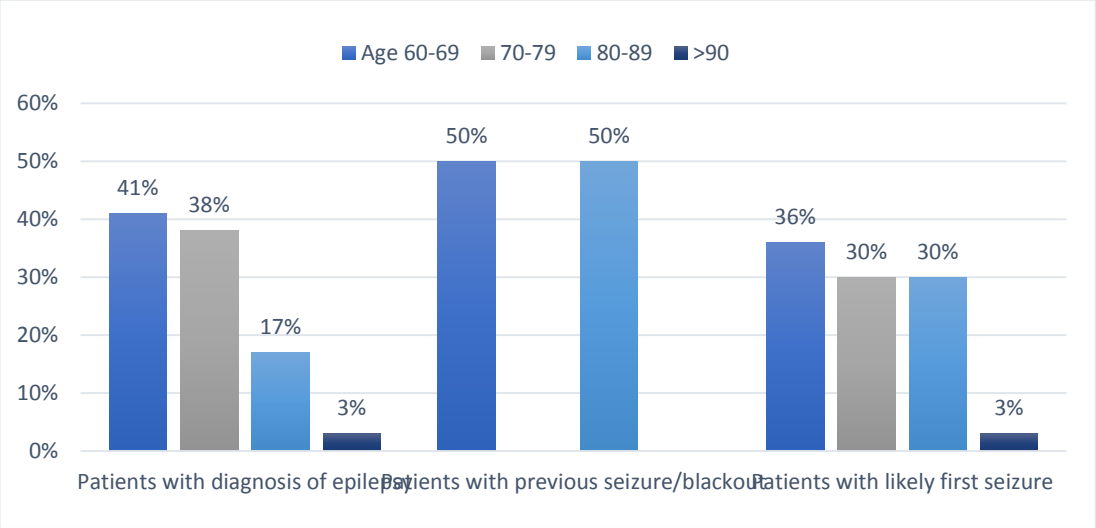


Table 11. CT head by age group and diagnosis

Age	Patients with diagnosis of epilepsy % (n=29)	Patients with previous seizure/blackout % (n=4)	Patients with likely first seizure % (n=33)
60-69	41% (12)	40% (2)	36% (12)
70-79	41% (11)	20% (1)	30% (10)
80-89	16% (5)	40% (2)	30% (10)
>90	3% (1)	0 (0)	3% (1)

CT, computed tomography.

Review of CT head imaging in patients with epilepsy showed that 97% (28/29) who had undergone imaging had no new abnormalities or acute changes. The one abnormal scan showed a new subdural haematoma. Patient GCS on admission was 9. 85% (28/33) of patients with a likely first seizure had a CT head scan which did not show any new abnormalities.

3.2.4 UHA - Care following admission

Patients who died during admission were excluded from analysis of follow-up arrangements.

1. Those recorded as having known epilepsy, prior to attendance, 6 deaths (n=52)
2. Those known to have had previous seizures or blackouts, but not a diagnosis of epilepsy, 0 deaths (n=12)
3. Those with likely first seizure, no previous seizures or blackouts or diagnosis of epilepsy, 3 deaths (n=37)

There was no documentation with regards to management in the event of future seizures for all patients.

In patients with known epilepsy 31% (16/52) were referred to neurology or epilepsy specialist on discharge. 50% (6/12) of those with previous blackouts and 27% (10/37) of patients with a likely first seizure were also referred.

Amongst those with known epilepsy 10% (5/52) were referred to another medical speciality, these included a mixture of cardiology, department for medicine for older people and acute medical unit clinics. 14% (5/37) of those with a likely first seizure were referred to another speciality, these included cardiology and stroke specialities.

In patients presenting with a likely first seizure 40% (4/10) aged 60-69 were referred to neurology or epilepsy specialist compared to 30% (3/10) of those aged 80-89. (Table 12, Figure 14)

Figure 14. Referral to specialist services by age group

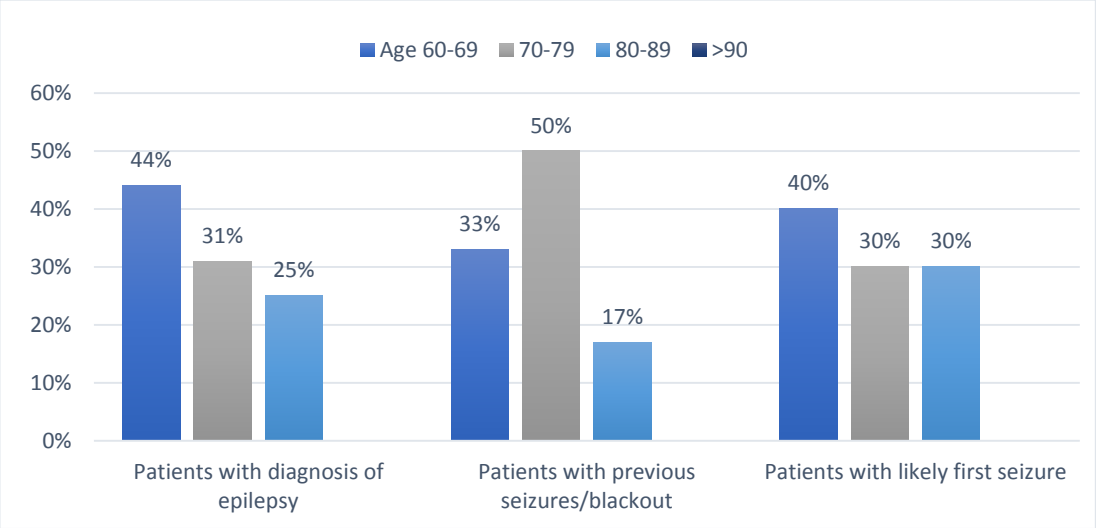


Table 12. Referral to specialist services by age group

	Patients with diagnosis of epilepsy % (n=52)	Patients with previous seizures/blackout % (n=12)	Patients with likely first seizure % (n=37)
Epilepsy specialist referral as outpatient	31% (16)	50% (6)	27% (10)
Age 60-69	44% (7)	33% (2)	40% (4)
Age 70-79	31% (5)	50% (3)	30% (3)
Age 80-89	25% (4)	17% (1)	30% (3)
Age >90	0% (0)	0% (0)	0% (0)

3.3 Results - Audit Royal Liverpool University Hospital

98 patients were identified. A&E admission notes could not be found for 22 patients. 16 patients' case notes were off site and could not be retrieved. Analysis was carried out on the remaining 60 patients (median age 75, IQR 69-81, 50% male).

For the purposes of analysis patients were divided into the following three categories:

1. Those recorded as having known epilepsy, prior to attendance (28/60, 47%)
2. Those known to have had previous seizures or blackouts, but not a diagnosis of epilepsy (4/60, 7%)
3. Those with likely first seizures, no previous seizures or blackouts or diagnosis of epilepsy (28/60, 47%)

3.3.1 RLH - Treatment prior to admission

In those with known epilepsy 60% (17/28) had presented to ED with a seizure in the preceding 12 months, as had 50% (2/4) of patients with a previous seizure or blackout. Only 4% (1/28) of patients presenting with a likely first seizure had attended ED in the preceding 12 months.

In patients with known epilepsy, 50% (14/28) had previously had a stroke, as had 25% (7/28) of patients presenting with a likely first seizure. 36% (10/28) of patients with epilepsy had a pre-existing diagnosis of dementia, with only 14% (4/28) of patients presenting with a likely first seizure having the diagnosis.

In those with a likely first seizure 36% (10/28) had two or more pre-existing comorbities. 43% (12/28) of patients with known epilepsy had two or more pre-existing comorbities and 36% (10/28) had two pre-existing comorbidities. (Table 13, Figure 15)

Figure 15. Number of comorbidities by diagnosis

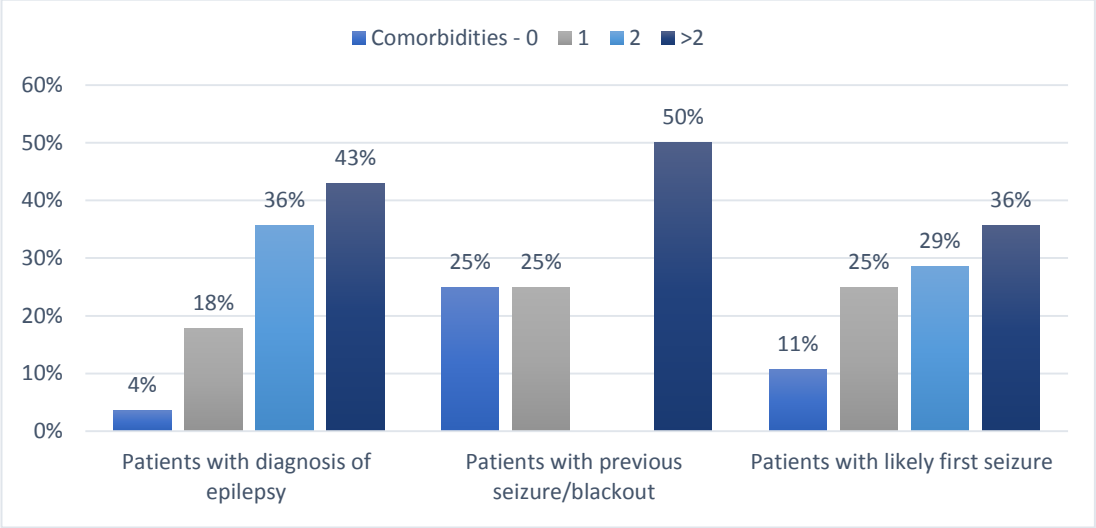


Table 13. Number of comorbidities by diagnosis

Number of comorbidities	Patients with diagnosis of epilepsy % (n= 28)	Patients with previous seizure/blackout % (n= 4)	Patients with likely first seizure % (n= 28)
0	4% (1)	25% (1)	11% (3)
1	18% (5)	25% (1)	25% (7)
2	36% (10)	0% (0)	29% (8)
>2	43% (12)	50% (2)	36% (10)

All patients with known epilepsy were on AED treatment (100%, 28/28). 64% (18/28) were on monotherapy, 36% (10/28) were on two or more AEDs or polytherapy. (Table 14, Figure 16)

Sodium valproate was the most commonly used AED, 54% (15/28). 36% (10/28) of patients were on sodium valproate monotherapy, 14% (4/28) were on levetiracetam monotherapy, 11% (3/28) on phenytoin monotherapy and 7% (2/28) on lamotrigine monotherapy.

Within the known epilepsy group 21% (6/28) of patients had been reviewed by an epilepsy specialist or neurologist in the preceding year. None of the patients with known epilepsy had a care plan in place.

Figure 16. Number of anti-epileptic drugs by diagnosis

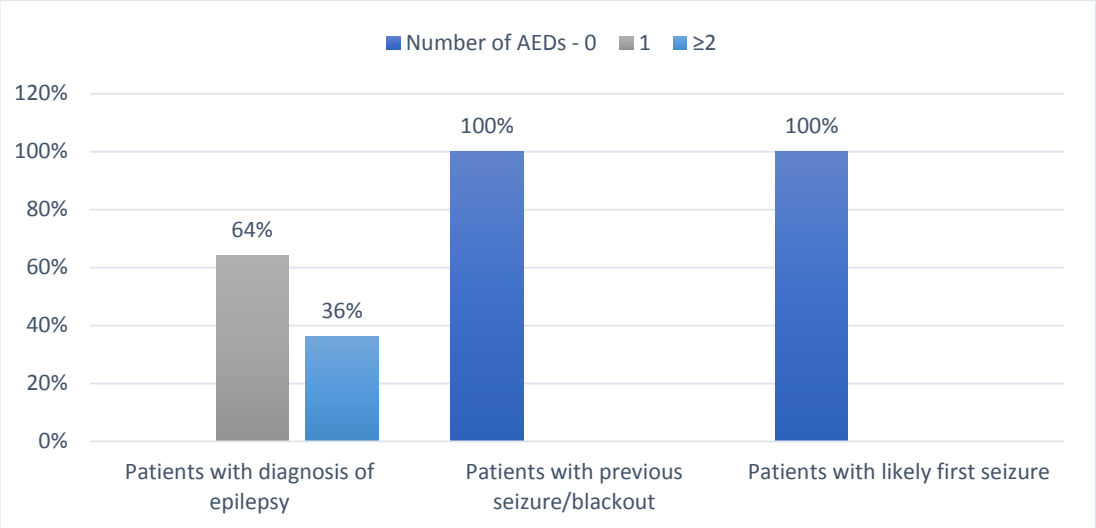


Table 14. Anti-epileptic drug treatment and review prior to presentation

	Patients with diagnosis of epilepsy % (n= 28)	Patients with previous seizure/blackout % (n= 4)	Patients with likely first seizure % (n= 28)
No AEDs	0% (0)	100% (4)	100% (2)
Monotherapy	64% (18)	0% (0)	0% (0)
Two or more AEDs	36% (10)	0% (0)	0% (0)
Specialist review previous 12 months	21% (6)	0% (0)	0% (0)

AED, anti-epileptic drug.

3.3.2 RLH - Assessment on arrival

GCS was checked in 93% (56/60) of all patients on arrival. All patients had their temperature, checked on arrival. 43% (12/28) of patients presenting with a likely first seizure and 25% (7/28) of those with known epilepsy had a neurological examination and plantars checked. None of the patients had examination of the fundi.

An eyewitness account was sought in 86% (24/28) of patients presenting with a likely first seizure. 89% (25/28) of patients with known epilepsy presenting to ED also had an eyewitness account. 14% (4/28) of patients presenting with a likely first seizure had documentation regarding alcohol consumption.

Senior review or discussion with a senior in ED within 4 hours of admission was carried out in 39% (11/28) of patients presenting with a likely first seizure and 43% (12/28) of patients with epilepsy.

All patients with known epilepsy were admitted to hospital (100%, 28/28) as were 93% (26/28) of those with a likely first seizure. (Table 15, Figure 17)

Figure 17. Admission to hospital and senior review in emergency department

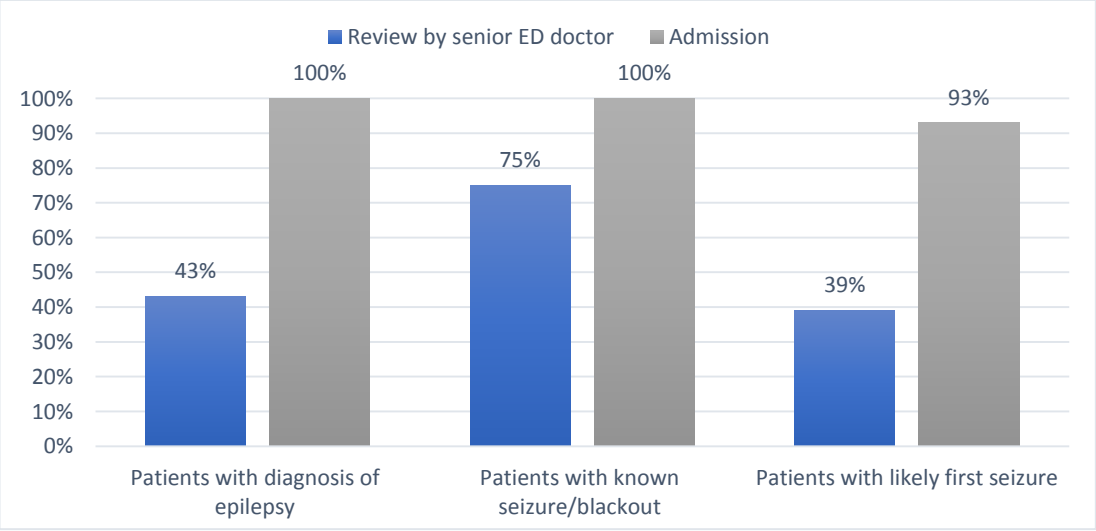


Table 15. Assessments on arrival to emergency department

	Patients with diagnosis of epilepsy % (n=28)	Patients with known seizure/blackout % (n=4)	Patients with likely first seizure % (n=28)
GCS score	96% (27)	100% (4)	89% (25)
Neurological exam	25% (7)	0% (0)	43% (12)
Eyewitness account	89% (25)	75% (3)	86% (24)
Review by senior ED doctor	43% (12)	75% (3)	39% (11)
Documented alcohol intake	11% (3)	25% (1)	14% (4)
Admission	100% (28)	100% (4)	93% (26)

GCS, Glasgow coma scale; ED, Emergency department.

3.3.3 RLH - Inpatient management

All patients had their glucose checked. ECG was carried out in 90% (27/28) of patients with known epilepsy and 89% (25/28) of patients presenting with a likely first seizure.

Computed tomography (CT) was the primary imaging modality carried out. 12% (7/60) of patients had an MRI scan on admission. 45% (13/28) of patients with a likely first seizure had a CT head on admission. 78% (21/28) of patients with known epilepsy, and 75% (3/4) of patients with previous seizure or blackout, also underwent CT imaging.

CT imaging was carried out in 69% (9/13) of patients with epilepsy who had a GCS of 13-15. 67% (14/21) of patients presenting with a likely first seizure with a GCS of 13-15 also had a CT scan. (Table 16, Figure 18)

Figure 18. CT head stratified by GCS score and diagnosis

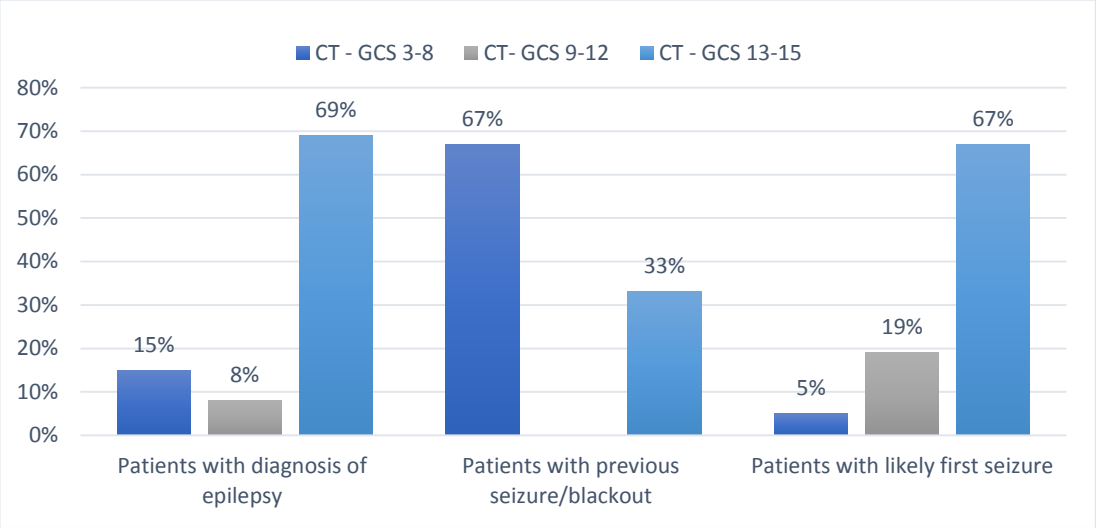


Table 16. Assessment and review during admission

	Patients with diagnosis of epilepsy % (n=28)	Patients with previous seizure/blackout % (n=4)	Patient with likely first seizure % (n=28)
CT	45% (13)	75% (3)	78% (21)
CT - GCS 3-8	15% (2)	67% (2)	5% (1)
CT- GCS 9-12	8% (1)	0% (0)	19% (4)
CT - GCS 13-15	69% (9)	33% (1)	67% (14)
CT - GCS unknown	8% (1)	0% (0)	10% (2)
ECG	96% (27)	100% (4)	89% (25)
Advice or review by neurology/epilepsy during admission	14% (4)	25% (1)	32% (9)

CT, computed tomography. ECG, electrocardiogram.

In patients presenting with a likely first seizure 19% (4/21) of those aged 60-69 had a CT scan as did 29% (6/21) of those aged 80-89. 23% (3/13) of 60-69 year olds with known epilepsy had CT imaging on admission compared to 31% (4/13) of those aged 80-89. (Table17, Figure 19)

Figure 19. CT head stratified by age group and diagnosis

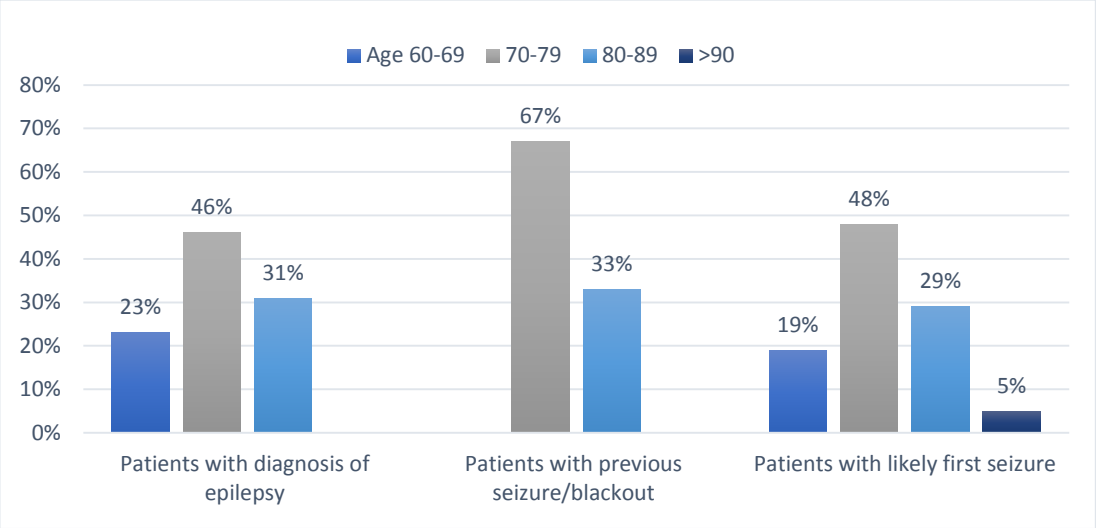


Table 17. CT head by age group and diagnosis

Age	Patient with diagnosis of epilepsy % (n=13)	Patient with previous seizure/blackout % (n=3)	Patients with likely first seizure % (n=21)
60-69	23% (3)	0% (0)	19% (4)
70-79	46% (6)	67% (2)	48% (10)
80-89	31% (4)	33% (1)	29% (6)
>90	0% (0)	0% (0)	5% (1)

Review of CT head imaging carried out in patients with epilepsy did not show any new abnormalities or acute changes in 92% (12/13) of patients. The one abnormal scan in this group showed a possible small frontal subdural haematoma. The patient had a recorded GCS of 14.

3.3.4 RLH – Care following admission

No patients died during their hospital admission. There was no documentation with regards to management in the event of future seizures for all patients.

Referral to a neurology or epilepsy specialist on discharge was undertaken for 14% (4/28) of patients with known epilepsy. 50% (2/4) of those with previous blackouts and 43% (12/28) of patients with a likely first seizure.. 7% (2/28) of patients with epilepsy were referred to another medical speciality, stroke. 18% (4/28) of those with a likely first seizure were also referred to another speciality, neurorehabilitation.

The data was not stratified by age group due to the small sample size per group. (Table 16, Figure 18)

Figure 20. Referral to epilepsy specialist services by diagnosis

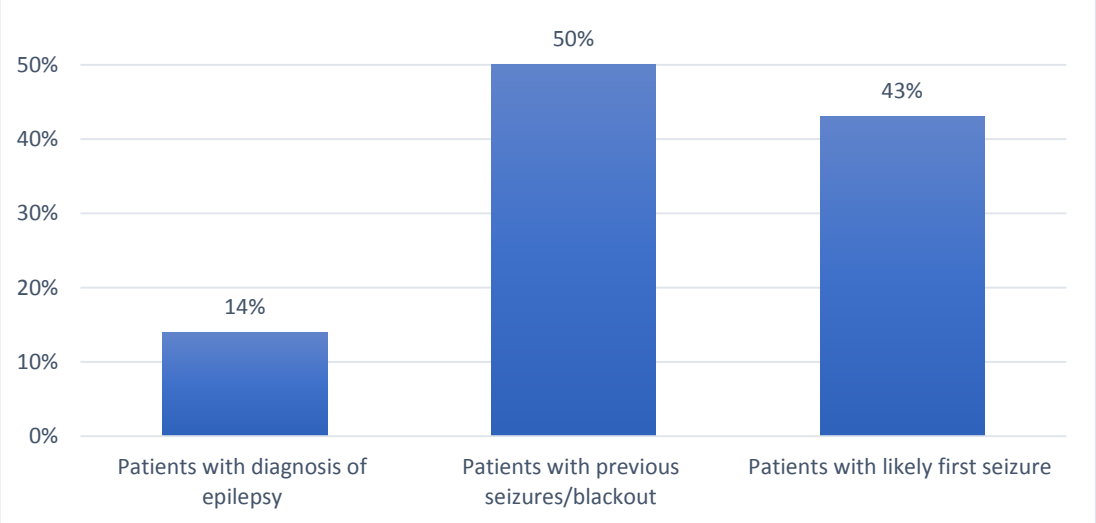


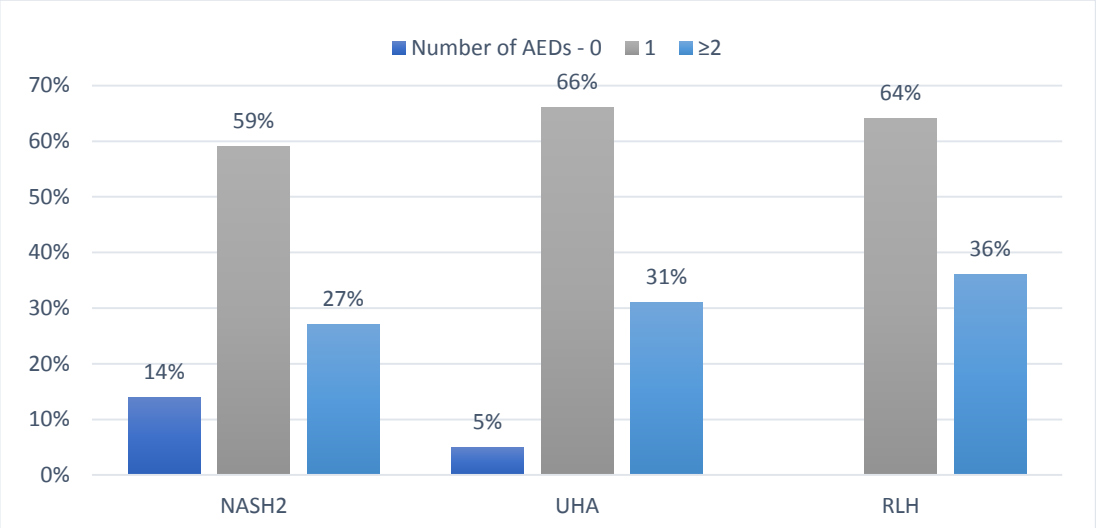
Table 18. Referral to specialist services

	Patients with diagnosis of epilepsy % (n=28)	Patients with previous seizures/blackout % (n=4)	Patient with likely first seizure % (n=28)
Epilepsy specialist referral as outpatient	14% (4)	50% (2)	43% (12)

3.4 Results - Comparison of National Audit Seizure Management in Hospital 2, University Hospital Aintree and Royal Liverpool University Hospital Audits

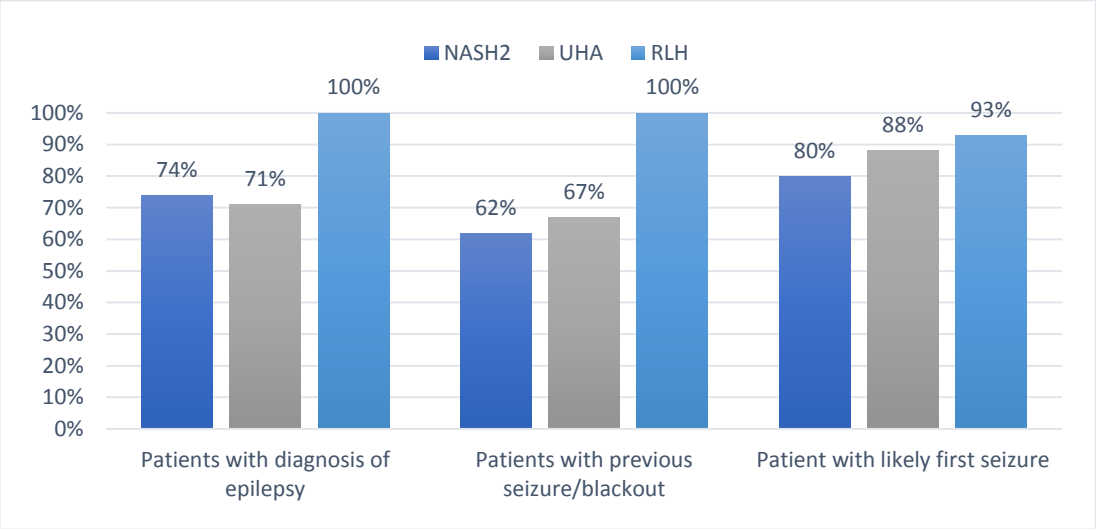
In patients with known epilepsy, 66% (38/58) attending UHA and 64% (18/28) of those attending RLH were on monotherapy compared to only 59% (377/640) of patients in NASH2. 27% (175/640) of patients in NASH2 were on polytherapy compared to 31% (18/58) attending UHA and 36% (10/28) attending RLH. (Figure 21)

Figure 21. Number of anti-epileptic drugs in patients with epilepsy - Comparison between NASH2, UHA and RLH audits



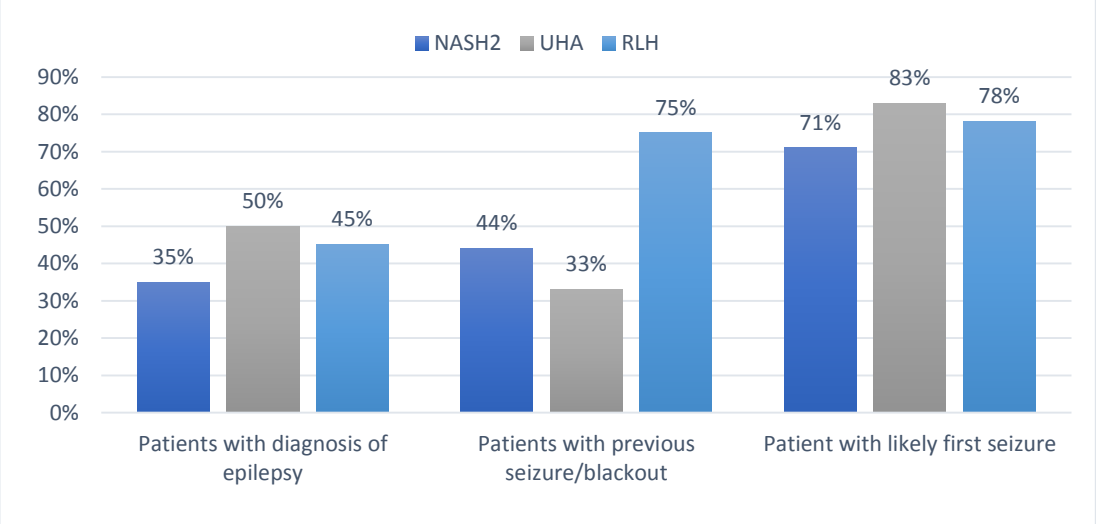
The rate of admission to hospital for patients with known epilepsy and previous blackout was highest for those attending RLH, with all patients who presented to ED being admitted to hospital. The rates of admission for patients with epilepsy were similar for UHA and NASH2. (Figure 22)

Figure 22. Admission to hospital - Comparison between NASH2, UHA and RLH audits



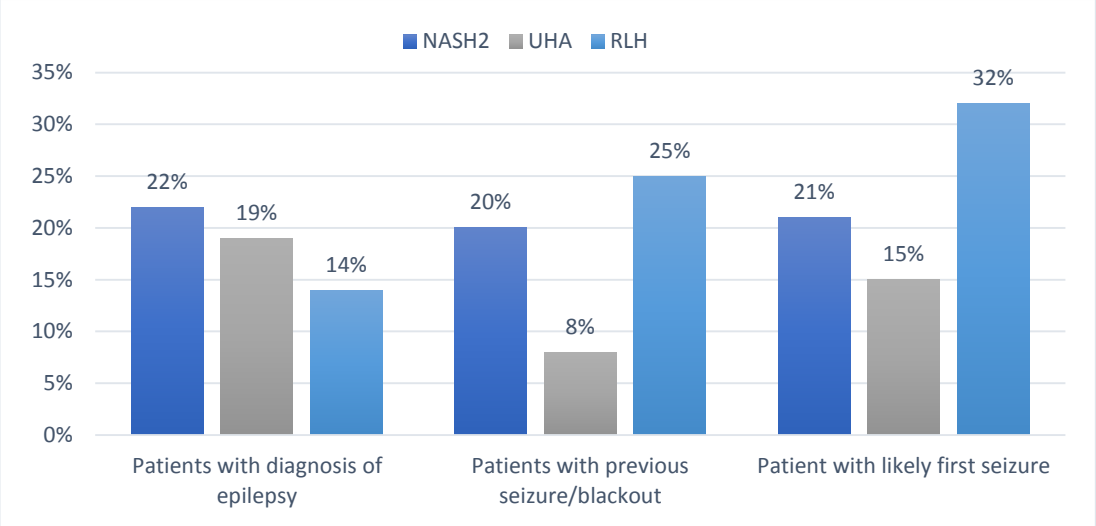
In those with known epilepsy 50% (29/58) presenting with a seizure to ED at UHA had CT head imaging as did 78% (21/27) for those attending RLH. The rates overall are much higher than those seen in NASH2 where 35% (226/640) of patients with known epilepsy, presenting with seizures had CT imaging. (Figure 23)

Figure 23. CT head - Comparison between NASH2, UHA and RLH audits



Advice or review by neurology during admission was requested in 32% (9/28) of patients presenting with a likely first seizure who attended RLH, compared to 15% (6/40) attending ED at UHA. In NASH2, 22% (143/640) of patients with epilepsy attending ED were discussed or reviewed by neurology compared to 14% (4/28) at RLH and 14% (8/58) attending UHA. (Figure 24)

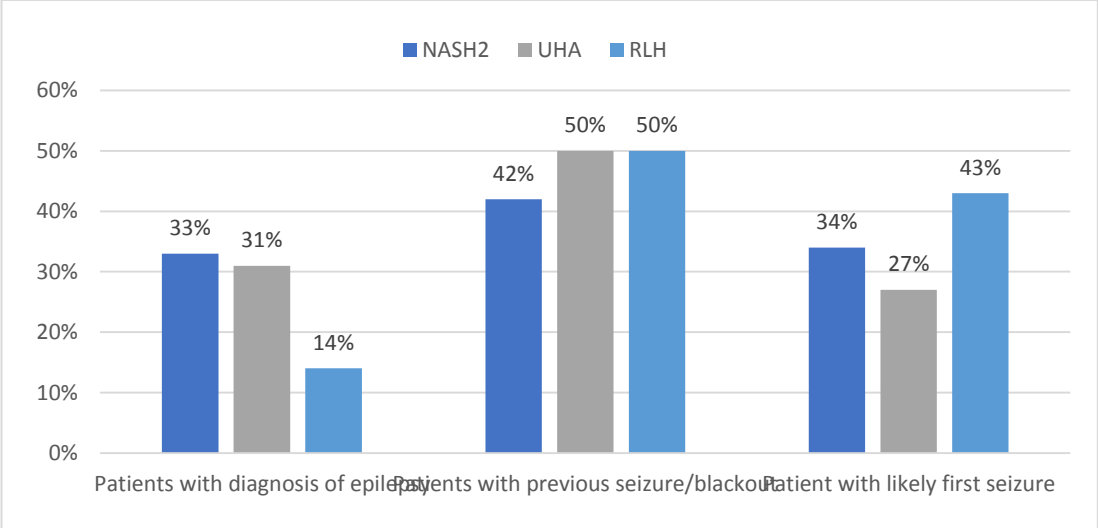
Figure 24. Advice or review by neurology during admission - Comparison between NASH2, UHA and RLH audits



Referral to neurology or specialist on discharge was carried out in 11% (3/27) of patients attending RLH with known epilepsy. These figures were higher for both NASH2, 33% (206/622) of patients were referred, and UHA where 31% (16/52) of patients were referred.

Referral to neurology or specialist on discharge for patients with a likely first seizure was carried out in 43% (12/28) of patients presenting to RLH, compared to 34% (131/390) in NASH2 and 27% (10/37) attending UHA. 50% of patients presenting with blackouts attending ED at UHA and RLH were referred to neurology or epilepsy specialist on discharge, compared to 42% (87/208) referred in NASH2. (Figure 25)

Figure 25. Referral to specialist services - Comparison between NASH2, UHA and RLH audits



Chapter 4. Discussion

4.1 Summary of Findings - National Audit for Seizure Management in Hospitals 2

Given the varying presentations, the diagnosis of epilepsy can be more difficult in older people. Within NASH2 under thirty percent of patients with a previous diagnosis of epilepsy, had evidence of having seen an epilepsy specialist in the previous year. It seems that a large proportion of patients with active epilepsy are not being seen within epilepsy services, which leads to missed opportunities to optimise treatment and avoid further admissions to ED.

Over half of patients with known epilepsy presenting with seizure to ED were on monotherapy. This again highlights the potential missed opportunity for improved seizure control. Breakthrough seizures in the elderly have consequences with regards to treatment, particularly in the context of polypharmacy, therefore input by specialist services is even more important.

Sodium valproate was the most commonly prescribed AED, with over forty percent of patients with epilepsy, on polytherapy, on this AED.

There was some variability with regards to investigations depending on diagnosis. ECGs were carried out in over ninety percent of patients presenting with a likely first seizure. However, this figure was lower for patients with a known diagnosis of epilepsy. It is important to recognize that older patients, even in the context of known epilepsy, can present with other pathologies leading to loss of consciousness and these should be explored.

There was a statistically significant difference in admission rates in patients with epilepsy and likely first seizure, when comparing those aged 60 and over to those

under 60, with higher rates of admission in those aged 60 and over. It is difficult to explore this further given the retrospective nature of NASH2, social circumstances and pre-existing comorbid conditions may play a part.

CT head imaging was undertaken in over seventy percent of patients presenting with a likely first seizure. Over thirty percent of patients with known epilepsy had CT head imaging. Patients' with a GCS of less than 13 were more likely to have CT imaging. The likelihood of CT head imaging did not vary considerably by age group. A significant number of patients with known epilepsy are having imaging following a seizure, this does not appear to correlate with age group.

The difference in the numbers of CT head imaging carried out in patient aged 60 and over and those under 60 is a statistically significant one, with higher rates of imaging seen in those aged 60 and over. Given the retrospective nature of NASH2 it is difficult to explore this further, however it is clear that a significant number of CT scans are carried out in patients with epilepsy presenting with a seizure.

Compared to imaging, examination of patient's fundi or plantar response was carried out in less than a third of patients, including those presenting with a first seizure. Although on the face of it imaging appears to have replaced basic neurological examination, this is likely to reflect lack of education and confidence in the management of these patients in ED.

Eyewitness accounts were sought in eighty percent of patients presenting with a likely first seizure. In patients with a known diagnosis of epilepsy this was lower at seventy-three. Eyewitness accounts remain crucial in helping to ascertain a diagnosis of seizure or epilepsy, as highlighted in national guidelines. It is equally important to try and gain an eyewitness account for patients with known epilepsy, to re-affirm the initial diagnosis and ensure that a secondary diagnosis for the event is not missed.

Advice on management of further seizures was given to just over twenty percent of patients presenting with a likely first seizure. Those aged 60 to 69 with epilepsy were almost twice as likely to be given advice regarding further events compared to those aged 80 to 89. Conversely those aged 80 to 89 presenting with a likely first seizure were more likely to receive advice.

Referral to neurology or epilepsy services on discharge was carried out in just over thirty percent of patients. Double the number of 60 to 69 year olds presenting with a likely first seizure were referred compared to 80 to 89 year olds. Over half of 60-69 year olds with known epilepsy, or previous seizure or blackout were referred on, compared to less than twenty per cent of 80 to 89 year olds.

There was a statistically significant difference in rates of referral to specialist services for patients with first seizure and epilepsy when comparing those aged 60 and over to the under 60, with higher rates of referral seen in those aged 60 and under.

The reasons for non-referral to services are unclear, and may include inability to refer within hospitals, lack of services or a combination. This however does not account for the disparity in the rate of referrals between patients aged 60 and over and those under 60.

4.2 Summary of Findings - University Hospital Aintree Audit

Over sixty percent of patients with epilepsy who attended ED had been seen by epilepsy specialists or neurologists in the preceding 12 months. This is higher than rates seen in NASH2, where just over thirty percent of patients with known epilepsy had been seen in specialist services. This may in part be due to the proximity of this hospital to a tertiary neurosciences' unit.

Although the figures from this analysis are higher than those from NASH2 there is still missed opportunity within this group of patients to optimise treatment.

Over seventy percent of patients with a diagnosis of epilepsy attending ED were on monotherapy or on no treatment. Sodium valproate was the most commonly used anti-epileptic with over a third of patients with epilepsy on treatment with this AED.

With regards to aetiology of seizures approximately forty percent of patients with known epilepsy had a previous diagnosis of stroke and around twenty percent had a pre-existing diagnosis of dementia. As well as epilepsy, over a third of these patients had two other comorbidities.

Approximately thirty percent of patients presenting with their first seizure had an existing diagnosis of dementia. Thirty eight percent of patients presenting with a likely first seizure had two or more pre-existing comorbidities.

The importance of appropriate management and use of anti-epileptic medication is even more important in this group of patients particularly given the adverse effects of AEDs and their potential interactions with other medications.

CT head imaging was carried out in more than eighty percent of patients with a likely first seizure. Conversely neurological examination was only carried out in a third of these patients.

More than fifty percent of patients with known epilepsy also had CT imaging, of these half had a GCS of 13-15. A higher percentage of patients with GCS of 13-15 had CT imaging compared to those with a GCS of less than 13.

Over ninety percent of patients with epilepsy who underwent CT imaging had scans which did not show any new abnormalities. This again highlights the high rate of CT imaging carried out in this group of patients, which for the majority does not lead to a change in management.

Discussion with a senior in ED was carried out almost twice as often in patients presenting with a likely first seizure compared to those with known epilepsy. Advice from neurology services was sought in over ten percent of patients with known epilepsy who were admitted. This was similar for patients presenting with a first seizure.

Over seventy percent of patients with known epilepsy were admitted to hospital as were almost ninety percent of patients presenting with a first seizure.

There was no documented evidence about management of future seizures for any of these patients. It is possible that this was verbally passed on to patients, however if we assume that lack of documentation equates to this not being done, patients are being discharged home without advice in the event of future seizures.

Approximately a third of patients with known epilepsy or likely first seizure are referred to neurology or specialist services on discharge. The rate of referral for patients with epilepsy decreases by increasing age bracket. With regards to onward referral to other specialities ten percent of patients with epilepsy and fourteen with a likely first seizure were referred to other medical specialities.

Patients aged 60 and over with a likely first seizure are not referred to specialist services on discharge nor are they referred to other specialties for assessment.

There is therefore ongoing missed opportunities for these patients to have their management improved and hopefully avoid future ED attendance.

4.3 Summary of Findings - Royal Liverpool Hospital

Twenty one percent of patients with epilepsy admitted to hospital had been seen by epilepsy specialists or neurologists in the preceding 12 months. This is lower than rates seen in NASH2, where just over thirty percent of patients with known epilepsy had been seen in specialist services.

Sixty-four percent of patients with epilepsy were on monotherapy. Sodium valproate was used in over half of patients with epilepsy on polytherapy, these figures being higher than both UHA and NASH2.

Fifty percent of patients with known epilepsy had a previous diagnosis of stroke and thirty-six percent had a pre-existing diagnosis of dementia. Over forty percent of patients with known epilepsy had more than two comorbid conditions in addition to epilepsy. These figures are higher than UHA, and it is difficult to explore this further. The difference may in part be related to the fact that these hospitals are in different geographic location within Liverpool and therefore may cater to different patient populations.

Thirty six percent of patients presenting with a likely first seizure had more than two pre-existing comorbidities. A quarter of patients presenting with a likely first seizure had a pre-existing diagnosis of stroke and fourteen percent had a pre-existing diagnosis of dementia.

CT imaging was carried out in almost eighty percent of patients with a likely first seizure. Conversely neurological examination was only carried out in forty-three percent.

Over sixty percent of patients with known epilepsy had CT imaging, and just over sixty percent of these had a GCS of 13-15. The number of CTs carried out appears to increase with GCS score, these findings are similar to those in UHA audit, but similar

trends were not seen in NASH2. It may be that these patients are too unstable to have CT imaging accounting for lower rates of CT imaging in patients with GCS of less than 13.

Again over ninety percent of patients with epilepsy who underwent CT head imaging did not have any new abnormalities on scan.

4.4 Limitations

As a retrospective audit, data collated in NASH2 could only be derived through information documented in the medical notes. As such some of the missing data may be due to variability of recording, or availability of the information at the time of data collection.

A group of patients without a known diagnosis of epilepsy were on anti-epileptic medication. The nature of data collection in NASH2 did not allow retrospective review to ascertain whether this was in error or whether these drugs had been prescribed for different indications.

Patients were divided into three groups in NASH2, and the same groups were retained for the purposes of analysis here. One of the groups contains patients where the diagnosis of epilepsy was not clear from the medical records. These patients were reported separately given that a retrospective diagnosis would not have been possible.

Both UHA and RLH audits carry the same drawbacks. Given the retrospective nature of both audits, data could only be collected based on the information documented in the medical notes. UHA audit was carried out in a hospital which is in close proximity to a tertiary neurosciences unit and this may have some bearing on the results.

4.5 Implications

Sodium valproate was the most commonly prescribed AED in NASH2 and local audits. This is likely to reflect the broad therapeutic spectrum and straightforward dosing schedule of this drug. (186-188)

Focal epilepsy is more likely to be refractory to treatment and there is evidence that sodium valproate is not the best first AED to achieve seizure freedom. (87, 144, 146, 171) A multi-centre double blind trial, comparing carbamazepine to sodium valproate, found that carbamazepine was more effective in the treatment of focal seizures, the two being equally effective for secondary generalised tonic–clonic seizures. Carbamazepine had fewer long term adverse effects than sodium valproate. (171)

Sodium valproate has also been implicated in reduction of bone density in older people increasing the risk of fractures in this group. (129, 172, 173) The continued use of sodium valproate reflects outdated practice and is likely to be a consequence of management of these patients in primary care or by non-specialist services.

To date only five randomised controlled trials of AED monotherapy in older people with newly diagnosed epilepsy have been carried out. (143, 145, 146, 159, 174) Four of the trials have shown comparable efficacy, in terms of time to first seizure, or seizure freedom between carbamazepine and lamotrigine. (143, 145, 146, 174)

Retention rates were higher for lamotrigine than carbamazepine in these trials, mainly due to better tolerability with lamotrigine. The only prospective randomised, double-blind trial comparing levetiracetam, lamotrigine and carbamazepine controlled release in older patients with newly diagnosed epilepsy showed similar efficacy of levetiracetam monotherapy compared to carbamazepine controlled release. Tolerability was superior in levetiracetam leading to increased effectiveness in terms of retention rates. (159)

These findings do not seem to be reflected in clinical practice judging by the results of NASH2 and local audits where, by comparison, only a small percentage of patients were on lamotrigine, carbamazepine or levetiracetam monotherapy.

A significant number of patients with known epilepsy are having imaging following a seizure. Whilst there appears to be some correlation between this and GCS score the same cannot be said when comparing patients aged 60 and over to those under 60 in NASH2. This may be due to longer resolution of post-ictal confusion, Todd's paresis or aphasia, thereby necessitating imaging in this group. (189)

Review of CT head reports in patients with epilepsy was carried out for UHA and RLH. This showed that over ninety percent had imaging which did not show any new abnormalities or acute changes. Previous studies have confirmed that CT imaging is carried out in over half of patients with epilepsy presenting to hospital with seizures. Prolonged altered consciousness, acute head trauma, and abnormal neurological examination at presentation were associated with an increased yield of ED neuroimaging. With the absence of any of these three clinical factors the true positive yield of neuroimaging was zero. (190)

Lack of confidence in the management of these patients in conjunction with lack of input from specialist services may have led to CT imaging being used more frequently than perhaps it ought to be. The need for imaging is likely to lead to longer admission times and perhaps unnecessary scans in this group of patients.

Following NASH1 various aspects of care were highlighted as requiring improvement, patients presenting with seizures were managed in ED and referral rates to specialist services on discharge were low. (191)

When comparing referral rates in patients aged under 60 to those aged 60 and over, for both epilepsy and first seizure, those aged 60 and over are far less likely to be referred to a specialist. This group is also not being referred to other medical specialities on discharge. This is in line with previous published data. (192)

Equitable access to specialist epilepsy services is important, particularly in older people where diagnosis can be more challenging. A study assessing this in Sheffield and Rotherham found that older patients with epilepsy were less likely to be referred to specialist neurology services than their younger counterparts, raising the possibility of age discrimination. (193) These findings are supported by the data collated in this study.

The same group in Sheffield and Rotherham explored possible reasons for non-referral, and identified a number of factors which may explain lower referral rates, including difficulty accessing hospital, patient reluctance to attend clinics, unclear referral pathway, complex differential diagnoses, referrer knowledge and time since onset. (194)

When older patients were surveyed on the same questions many directly disagreed with these views. This data suggests that healthcare professionals may make assumptions about older people in terms of their willingness and ability to attend hospital appointments. (195) The sample size of professionals and patients was small and therefore further studies are needed to assess healthcare professionals' attitudes.

Older patients presenting with seizures are more likely to be admitted to hospital. Their other comorbidities and also safety concerns if they live alone, are factors which will influence admission and may make this more likely. Advice on what to do in the event of further seizures is generally poor. It might be helpful for ED departments to have information leaflets available to give to patients on discharge.

Chapter 5. Recommendations

The findings above show that there is inequality in access to specialist services in older people and this may in part reflect inadvertent age discrimination by clinicians. Given the rapidly increasing ageing population clinicians' attitudes to the management of older patients must change in line with changing demographics.

Whilst distance of travel may be related to difficulty accessing neurology or specialist clinics, these patients are not even considered for referral. This would imply that ED clinicians do not feel that this cohort of patients require review in either neurology or other medical speciality clinics. Clinician attitudes to management of this patient group has not been explored in the literature and further research is needed to establish why older patients with seizures and epilepsy are not managed more frequently in specialist care.

The number of CT scans carried out in patients with epilepsy presenting to ED is far higher than one would expect. Conversely a neurological examination is carried out far less frequently. This is may highlight a degree of uncertainty by ED clinicians regarding the management of patients with epilepsy and seizures and further studies are required to explore this further.

Lack of education, and perhaps lack of engagement with ED physicians, may be in part to blame for this trend. Teaching on management of seizures and epilepsy to EDs and acute medical units will give clinicians more confidence in assessment, investigation, management and choice of appropriate first line AED.

Implementation of local referral pathways and guidelines, to help guide assessment, investigation, management and onward referral of patients with seizures and epilepsy is also likely to help increase clinician confidence.

It is equally important to highlight to referring trusts the services available from local neuroscience units for patients with seizures and epilepsy. This would increase assurance that these patients will be seen and assessed promptly, and thereby reducing the need for longer inpatient stays and investigation.

Although improving management and increasing referral rates is important, considering their comorbidities and driving restrictions, older patients are likely to need access to local community clinics. This will require a review of the provision of services by healthcare providers to allow sufficient capacity in neurology and other specialist clinics for this patient cohort.

Overall a combination of education, restructuring of services and further research will be required to improve standards of care for older patients with epilepsy and seizures.

Chapter 6. Conclusions

There is considerable variation in the documented care of patients with seizures attending hospital and this is evident throughout the care pathway. Better management of these patients in the community would lead to lower admission rates in hospital.

With a rapidly expanding ageing population, we have to be even more inclusive of the healthcare needs of this group of individuals, which can fundamentally improve their quality of life as well reducing unnecessary investigations and thereby longer hospital admissions.

Although review of these patients within epilepsy services is ideal, this may not be feasible for every patient. Therefore, a stronger network between epilepsy specialists, primary care and elderly care physicians is needed to improve management and lower admission rates, thereby bringing about large cost savings.

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Appendix 1.

NASH2 Clinical Proforma Questions

Q1.1 Auditor discipline
Options:
Doctor
Nurse
Other health professional

Q2.2 Age

Q2.3 Gender
Options:
Male
Female

Q2.4 Does the patient live in the geographical location covered by this trust?
Options:
Yes
No/Not documented
Q3.1 Is there a statement that the patient is known to have epilepsy?
Options:
Yes
No/Not documented

Q3.2 Does the patient have a written care plan in place?
Options:
Yes
No/Not documented

Q3.3 Is there documentation that the patient has had previous seizures or blackouts?
Options:
Yes
No/Not documented

Q3.3a Was the patient's previous seizure or blackout provoked by alcohol?
Options:
Yes
No
Not documented

Q3.3b Was the patient's previous seizure or blackout provoked by head injury?

Options:
Yes
No
Not documented

Q3.3c Was the patient's previous seizure or blackout provoked by other?
Options:
Yes (if yes – please specify)
No
Not documented

Q3.4 Has the patient attended this Emergency Department as a result of a sezirue in the previous 12 months?
Yes
No
Not documented

Q3.5 On attendance which anti-epileptic drugs was the patient being prescribed?
Options:
Carbamazepine/Tegretol/ Tegretol Retard
Lamotrigine/Lamictal
Levetiracetam/Keppra
Phenytoin/Epanutin
Sodium Valproate/Epilim/Epilim Chrono/Orlept
Acetazolamide/Diamox
Clobazam/Frisium
Clonazepam/Rivotril/ Rivatril
Diazepam/Valium
Eslicarbazepine Acetate/ Zebinix
Ethosuximide/Emeside/ Zarontin
Gabapentin/Neurontin
Lacosamide/Vimpat
Oxcarbazepine/Trileptal
Oxazepam/Serax
Perampanel/Fycompa
Pregabalin/Lyrica
Phenobarbital
Primidone/Mysoline
Retigabine/Trobalt
Rufinamide/Inovelon
Stiripentol/Diacomit
Sulthiame/Ospolot
Tiagabine/Gabatril
Topirimate/Topamax
Vigabatrin/Sabril
Zonisamide/Zonegran

Q3.6a Is it documented that the patient has seen an Epilepsy Specialist Nurse within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6b Is it documented that the patient has seen a GPSI (neurology, epilepsy or neuropsychiatry) within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6c Is it documented that the patient has seen a learning disability psychiatrist within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6d Is it documented that the patient has seen a neurologist within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6e Is it documented that the patient has seen a paediatrician within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6f Is it documented that the patient has seen a paediatric neurologist within the previous 12 months?
Options:
Yes
No
Not documented

Q3.6g Is it documented that the patient has seen a neurosurgeon within the previous 12 months?
Options:
Yes
No

Not documented

Q3.7 Is the patient recorded as having a learning disability?
Options:
Yes
No/Not documented

Q4.1 When did the patient arrive in the Emergency Department?
Date

Q4.2 Is there evidence of senior Emergency Department review, i.e. was the patient seen (or was there a consultation regarding the patient)?
Options:
Yes
No
Not documented

Q4.2a Was this within 4 hours of arrival in the Emergency Department?
Options:
Yes
No
Not documented

Q4.2b Were they seen by a consultant?
Options:
Yes
No
Not documented

Q4.2a Were they seen by a ST4 or above?
Options:
Yes
No
Not documented

Q5.1a Is it documented that diazepam (rectal or IV) was administered prior to arrival at hospital?
Options:
Yes
No

Q5.1a1 Who was the diazepam administered by?
Options:
Family member/carer
GP
Ambulance staff
Other - please specify

Q5.1b Is it documented that midazolam was administered prior to arrival at hospital?
Options:
Yes
No

Q5.1b1 Who was the midazolam administered by?
Options:
Family member/carer
GP
Ambulance staff
Other - please specify

Q5.1c Is it documented that an other drug (oral clobazam, iv lorazepam or paraldehyde) was administered prior to arrival at hospital?
Options:
Yes
No

Q5.1c1 Who was the other drug administered by?
Options:
Family member/carer
GP
Ambulance staff
Other - please specify

Q5.2 Had the seizure stopped by the time of arrival in the emergency room?
Options:
Yes
No
Unclear

Q5.2a What treatment was given in the emergency room?
Options:
IV diazepam
Rectal diazepam
Buccal midazolam
IV glucose
IV levetiracetam
IV lorazapam
IV phenobarbitol
IV phenytoin
IV thiamine / pabrinex
IV valproate
Rectal or intramuscular paraldehyde

Q6.1 Was the patient fully conscious upon arrival at the Emergency Department?

Options:
Yes
No
Don’t know

Q6.2a Was the patient’s temperature taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2a1 What was the patients’ temperature?
Options:
Numeric figure

Q6.2a2 Was their temperature taken within 20 minutes of arrival?
Options:
Yes
No/Don’t know

Q6.2b Was the patient’s pulse taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2c Was the patient’s blood pressure taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2d Was the patient’s oxygen saturation taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2e Was the patient’s respiratory rate taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2f Was the patient’s GCS taken in the Emergency Department?
Options:
Taken
Not taken/Don’t know

Q6.2f1 What was their GCS score?
Options:
1-15

Q6.3 In the 4 hours following the patient's arrival at the Emergency Department was a neuro obs chart in place?
Options:
Yes
No/Don't know

Q6.4 Where was the patient transferred or admitted to, directly from the Emergency Department?
Options:
Clinical decision unit
ED observational ward
EMU or equivalent
Intensive Care Unit
Medical decision unit
Medical ward
Neurology ward
Other - please specify
Discharged

Q6.4a For all patients except those who were discharged (or for whom the answer to the previous question was missing), who took over the care of the patient during admission?
Options:
Neurologist
General physician
Other
Remained under care of Emergency Department

Q6.4b For all patients except those who were discharged (or for whom the answer to the previous question was missing), how long was the patient admitted for?
Options:
Days
Hours

Q6.4c For patients who were moved to the Intensive Care Unit, what were they treated with?
Options:
Heminevrin Yes; No; Don't know
Midazolam Yes; No; Don't know
Phenobarbitol/phenobarbitone Yes; No; Don't know
Propofol Yes; No; Don't know
Thiopentone Yes; No; Don't know
Other - please specify Yes; No; Don't know

Q6.5 Was an eyewitness to the seizure contacted?
Options:

Yes
No
Don’t know
Event unwitnessed

Q6.5a If no to the above, is there a statement that an attempt was made to conatact an eyewitness?
Options:
Yes
No

Q6.6 Is there documentation that the patient was asked as to whether or not they are a driver?
Options:
Yes
No
Not applicable

Q6.7 Is there documentation of the patient’s general alcohol intake?
Options:
Yes
No
60

Q6.7a How is their drink intake best classified?
Options:
Excessive
Moderate
Low

Q6.8 In the week prior to arrival at the Emergency Department is it documented that the patient has been on an alcoholic binge?
Options:
Yes
No

Q6.9 Is there documentation that the patient does or does not use illicit drugs?
Options:
Yes
No

Q6.9a Are they a user or a non-user?
Options:
User
Non-user

Q6.9b Which drugs do they use?

Options:
Cannabis
Opiates
Stimulants
Other - please specify

Q6.10 In the 24 hours prior to arrival at the Emergency Department is it documented that the patients has been using illicit drugs?
Options:
Yes
No

Q6.11a Is there documentation of a fundi examination being undertaken at any time during attendance at the Emergency Department?
Options:
Yes
No

Q6.11b Is there documentation of a plantar examination being undertaken at any time during attendance at the Emergency Department?
Options:
Yes
No

Q7.1 Is it documented that at any point in time advice was sought from a neurology / epilepsy team, or an assessment taken by a neurologist or epilepsy specialist?
Options:
Yes
No
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Q7.1a From whom was advice sought?
Options:
Epilepsy Specialist Nurse
Neurologist
Neuropsychiatrist
Neurosurgeon
Paediatrician
Paediatric neurologist

Q8.1a Were antiepileptic drug level investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don’t know

Q8.1b Were CT (head) investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don't know

Q8.1c Were ECG investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don't know

Q8.1d Were EEG investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don't know

Q8.1e Were glucose levels/BM investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don't know

Q8.1f Were MRI (head) investigations undertaken following attendance in the Emergency Department?
Options:
Yes
No
Don't know

Q8.2 Did the patient die during their admission?
Options:
Yes
No

Q8.2a What was the cause of death?
Options:
Free text entries

Q8.3a Was a CT (head) investigation requested as an outpatient following discharge?

Options:
Yes
No
Don’t know

Q8.3b Was a EEG investigation requested as an outpatient following discharge?
Options:
Yes
No
Don’t know

Q8.3c Was a MRI (head) investigation requested as an outpatient following discharge?
Options:
Yes
No
Don’t know

Q8.3d Was a 12 lead ECG investigation requested as an outpatient following discharge?
Options:
Yes
No
Don’t know

Q9.1 What was the diagnosis at discharge/death?
Options:
Blackout with seizure markers, not sure if seizure
Syncope/faint
First unprovoked seizure
Unprovoked seizures with history of previous seizures, but no current epilepsy diagnosis
Seizure in someone with established diagnosis of epilepsy
Provoked seizure – alcohol induced
Provoked seizure – drug induced
Provoked seizure – head injury
Provoked seizure – acute stroke
Psychogenic non-epileptic attack / pseudoseizure
Self-discharged
Other - please specify
Not recorded

Q9.2 Was the patient sent home on any antiepileptic drugs?
Options:
Yes
No/Don’t know

Q9.2a Which drugs were they sent home on?
Options:
Carbamazepine/Tegretol/ Tegretol Retard
Lamotrigine/Lamictal
Levetiracetam/Keppra
Phenytoin/Epanutin
Sodium Valproate/Epilim/Epilim Chrono/Orlept
Acetazolamide/Diamox
Clobazam/Frisium
Clonazepam/Rivotril/ Rivatril
Diazepam/Valium
Eslicarbazepine Acetate/ Zebinix
Ethosuximide/Emeside/ Zarontin
Gabapentin/Neurontin
Lacosamide/Vimpat
Oxcarbazepine/Trileptal
Oxazepam/Serax
Perampanel/Fycompa
Pregabalin/Lyrica
Phenobarbital
Primidone/Mysoline
Retigabine/Trobalt
Rufinamide/Inovelon
Stiripentol/Diacomit
Sulthiame/Ospolot
Tiagabine/Gabatril
Topirimate/Topamax
Vigabatrin/Sabril
Zonisamide/Zonegran

Q9.3 Was advice about driving to the patient given?
Options:
Yes
No
Don't know
Not applicable (patient does not drive)

Q9.3a Was it that they should stop driving?
Options:
Yes
No
Don't know

Q9.3b Was it that they should inform DVLA?
Options:
Yes

No
Don’t know

Q9.4 Was the management of future seizures discussed with the patients or carers?
Options:
Yes
No
Not documented

10.1a Was the patient referred to an epilepsy service or first fit clinic?
Options:
Yes
No
Don’t know

10.1b Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1c What was the date of their appointment?
Options:
Free text
Date not known

10.1d What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

10.1e Was the patient referred to an epilepsy specialist nurse?
Options:
Yes
No
Don’t know

10.1f Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1g What was the date of their appointment?
Options:
Free text
Date not known

10.1h What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

10.1i Was the patient referred to a GPSI epilepsy?
Options:
Yes
No
Don’t know

10.1j Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1k What was the date of their appointment?
Options:
Free text
Date not known

10.1l What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

10.1m Was the patient referred to a learning disability psychiatrist?
Options:
Yes
No

Don’t know
10.1n Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1o What was the date of their appointment?
Options:
Free text
Date not known

10.1p What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

10.1q Was the patient referred to a neurologist at this Trust / Health Board?
Options:
Yes
No
Don’t know

10.1r Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1s What was the date of their appointment?
Options:
Free text
Date not known

10.1t What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure

Other - please specify

10.1u Was the patient referred to a neurologist at another Trust / Health Board?
Options:
Yes
No
Don’t know

10.1v Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1w What was the date of their appointment?
Options:
Free text
Date not known
10.1x What was their diagnosis?
Options:
Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

10.1y Was the patient referred to an alcohol/drug liaison service?
Options:
Yes
No
Don’t know

10.1z Did the patient attend their appointment?
Options:
Yes
No
Don’t know

10.1aa What was the date of their appointment?
Options:
Free text
Date not known

10.1bb What was their diagnosis?
Options:

Blackout of uncertain cause
Blackout with other cardiac cause
Epilepsy
First epileptic seizure
Non epileptic attack disorder (NEAD)
Syncope/fait/low blood pressure
Other - please specify

Q10.2 Was an A&E discharge letter provided to the patient's GP following their attendance at ED?
Options:
Yes
No
Don't know

Q10.2a Did the letter ask their GP to arrange onward referral?
Options:
Yes
No
Don't know

Appendix 2.

Audit Collection Proforma: UHA and RLH Audit

Demographics

Patient audit number	
Age	
Gender (Male/Female)	

Clinical information

Is the patient known to have epilepsy? (Please circle) Yes No
Is there a written care plan in place? (Please circle) Yes No
Documentation of previous seizures/blackouts? (Please circle) Yes No **If Yes date of last seizure/seizures**…… …… **Was the seizure provoked by: (Please circle)** alcohol head injury other (specify)…… ……
Has there been admission in the last 12 months to the department due to seizure? (Please circle) Yes No Unknown

Any other known comorbidities? (Please list) …… ……
Does the patient drink alcohol? (Please circle) Yes No Unknown **If Yes how many units a week**…… …….
Does the patient use illicit drugs? (Please circle) Yes No Unknown **If Yes specify time drugs last used**…… ……
Antiepileptic medication on admission (Please list) …… ……
Other medication on admission (Please list) …… ……
Does the patient drive? (Please circle) Yes No Unknown
Is the patient under the care of Walton Centre for management of their epilepsy? (Please circle) Yes No Unknown If yes date of last appointment/name of person seen……

Admission

Date and time of admission to A&E ……
Was there A&E senior review within 4 hours (SpR/Consultant)? (Please circle) Yes No Unknown

Were any of the following medication given prior to admission and if so by whom? Diazepam Yes No (Paramedic/GP/Family/Other - specify)…… Midazolam Yes No (Paramedic/GP/Family/Other - specify)…… Other (Lorazepam/Clobazam/Paraldehyde) Yes No (Paramedic/GP/Family)……
Had seizure stopped on arrival to A&E? (Please circle) Yes No Unknown
Was an eyewitness account sought? (Please circle) Yes No Unknown

Observations/Examination

What was the patient's GCS on arrival? Eyes…….Verbal…….Motor…….. Total ……../15
Was a neuro observation chart started within 4 hours of admission? (Please circle) Yes No Unknown
Which of the following were checked? (Please circle) Temperature Yes No Unknown Blood pressure Yes No Unknown Heart rate Yes No Unknown O2 saturation Yes No Unknown Respiratory rate Yes No Unknown
Was a neurological examination carried out? (Please circle) Yes No Unknown
If yes is there documentation of the following? (Please circle) Plantar response Yes No Unknown

Fundoscopy	Yes	No	Unknown

Investigations

Were any of the following investigations carried out as an inpatient? (Please circle)			
Anti-epileptic blood levels	Yes	No	Unknown
Glucose levels	Yes	No	Unknown
Electrolytes (Na/Ca)	Yes	No	Unknown
CT head	Yes	No	Unknown
MRI head	Yes	No	Unknown
EEG	Yes	No	Unknown
ECG	Yes	No	Unknown
Were any of the following investigations arranged on an outpatient basis? (Please circle)			
CT head	Yes	No	Unknown
If yes date arranged……..			
MRI head	Yes	No	Unknown
If yes date arranged……..			
EEG	Yes	No	Unknown
If yes date arranged……..			
ECG	Yes	No	Unknown
If yes date arranged……..			

Inpatient stay

Where was the patient transferred/admitted to from A&E? (Please circle)	
Clinical decision unit (or equivalent)	Neurology
Medical assessment unit (or equivalent)	Intensive care unit
Medical ward	Discharged
What was the duration of admission (hours/days)?	
Total number: ……hours ……days	

Did the patient die during admission? (Please circle)	
Yes	No

Diagnosis/Discharge

What was the diagnosis on discharge? (Please circle)	
Seizure (Patient with known epilepsy) First unprovoked seizure Blackout with seizure markers (not clear if seizure) Syncope/faint Non-epileptic attack Self discharged	Provoked seizure – acute stroke Provoked seizure – alcohol induced Provoked seizure – head injury Provoked seizure – drug induced Provoked seizure – other (sepsis/metabolic/tumour etc/please specify)……
Was advice about driving given? (Please circle)	
Yes	No Unknown
Was the patient discharged home on anti-epileptic medication? (Please circle)	
Yes	No Unknown
If Yes please list medication……	
Was the patient referred to a neurologist for follow-up? (Please circle)	
Yes	No Unknown
Was the patient referred to any other hospital speciality for follow-up? (Please circle)	
Yes	No Unknown
If Yes please list specialist……	

Appendix 3.

Publications.

Ziso B, Dixon PA, Marson AG. Epilepsy management in older people: Lessons from the National Audit of Seizure management in Hospitals (NASH2). Seizure. 2017;50:33-37.