

Manuscript

Title:

Improving accessibility to outpatient clinics for adults with suspected seizures from the emergency department: A quality improvement project.

Abstract

Introduction

Seizure-related presentations or suspected seizures, (i.e. epileptic seizures, PNES, cardiogenic and acute symptomatic seizures) comprise 1.9% of the entire caseload for the Mid Yorkshire Hospitals NHS Trust, United Kingdom in 2020. Patients with suspected seizures who are diagnosed in the emergency department (ED) require appropriate immediate management and a robust follow-up pathway. National audits conducted in the United Kingdom (UK) (NASH 1, 2 and 3) have highlighted the wide intersite variability in care provided towards patients with suspected seizures and the need for better organised and accessible care. This quality improvement (QI) project aimed to improve patient safety by ensuring a streamlined referral process from the ED and subsequently reducing the risk of loss to follow-up.

Methods

This QI project used the Institute of Healthcare Improvement (IHI) model for improvement to drive change and Lewin's change management model to guide stakeholder interaction. The project started in 2018 and employed three distinct Plan-Do-Study-Act (PDSA) cycles to drive improvement. The outcome measure was waiting time to be seen at the first seizure clinic from ED discharge.

Results

The median waiting time pre-QI was 65.0 days (range 37 days to 163 days), and the median waiting time post-intervention was 31.0 days (range 8 days to 175 days). Using log-transformed data, the reduction in mean daily waiting time following the introduction of the intervention was statistically significant at the 5% significance level ($t_{30,9}=9.42$; $p<0.001$).

Process measures were met with 100% compliance. Post-intervention period, there was a 4.1% (10/243) rejection rate of referrals from the ED by the neurology services. However, the project failed to meet NICE's recommendation of a waiting time of 14 days to be seen in the first seizure clinic.

Discussion and Conclusion

This QI project has made significant improvements in the management of patients presenting with suspected seizures to the ED's at MYHT. Additionally, the project has provided opportunities for development of new protocols, cost savings and patient advice leaflets. Teamwork and organisational skills played a crucial part in the outcome of this QI project. The use of a theory-driven change management strategy was key to managing a large organisation with multiple stakeholders.

1. Introduction

Suspected seizures is a diagnostically heterogeneous term used to categorise a number of seizure-related diagnoses such as epileptic seizures, acute symptomatic seizure, psychogenic non epileptic seizure (PNES) and cardiogenic events(1). Epilepsy as a diagnosis (under the broader term of suspected seizures) has three distinct subgroups: (i) epileptic seizure (first fit); (ii) epileptic seizure (epileptic diagnosis); (iii) epileptic seizure (not a first fit, no epilepsy diagnosis). It is important to highlight that in most cases, the diagnosis of first seizure does not meet the definition of epilepsy as defined by the International League Against Epilepsy (ILAE)(2). However, patients who fall under the diagnostic spectrum of suspected seizures may end up with the diagnosis of epilepsy. The diagnosis of epilepsy is life-changing and carries a significant legal, psychological and socioeconomical impact on the patient.

The conclusion from multiple audits (National Audit on Seizure Management in Hospitals (NASH))(3, 4) and studies (Epilepsy Pre-Hospital Interventions and Care 1&2)(1) have corroborated that most patients with suspected seizures presenting to the hospital are discharged without the appropriate level of inpatient or outpatient specialist input. This phenomenon raises significant patient safety concerns and may result in increased mortality, morbidity and cost to the NHS. Suspected seizures present a serious demand on the emergency care services both pre-hospital and in hospital(5). A significant number of patients with epilepsy have had their initial diagnosis established by an emergency department (ED) (6). Therefore, the onus is upon the ED physician to establish an accurate diagnosis through careful history-taking, examination and by organising the relevant investigations for further specialist input.

Not all patients presenting to the ED with suspected seizures require admissions. Nevertheless, disposition from the ED is complicated with the inherent diagnostic uncertainties relevant to the specialty and social factor considerations(5). Management of the mentioned cohort of patients in the ED are at most times sub-optimal, with varying levels of consistency throughout the UK.

The NASH audits have highlighted that there was a “wide intersite variability in care covering the entire pathway, and a better need for organised and accessible care for these patients”(3) It is also established that onwards referral for specialist input occurred for less than half of patients and there was a significant rate of non-attendance. Loss of follow-up due to discoordinate care is a significant issue that needs to be addressed at a fundamental level, as prompt referral to specialist clinics reduces premature mortality (4).

1.2 Local Setting

The Mid Yorkshire Hospitals NHS Trust (MYHT) is a busy acute trust in the West Yorkshire region of the United Kingdom, comprising two EDs and an urgent treatment centre. In 2020, the MYHT had 175,000 attendances to both EDs. Seizure-related presentations (i.e., tonic-clonic seizures, partial seizures, status epilepticus and first seizures) comprised 1.9% of the entire caseload for both EDs at MYHT in 2020 (3,320 presentations with seizures for both adult and paediatric patients). In the NASH2 local audit report, issues identified in ED management were documentation-related; poor documentation of full neurology, driving advice and alcohol intake. In addition, other issues identified were lack of senior ED clinician involvement and inconsistent follow up arrangements made upon discharge. The local census and NASH reports concur with the national data and unearthed significant concerns with how patients with suspected seizures are being managed in the emergency care setting.

Prior to our QI initiative (in 2018), there were inconsistencies regarding how suspected seizures should be investigated and referred to first-fit clinics from the ED. Various methods were used by

clinicians, including referral to a GP, referral to an ambulatory care unit (ACU) and personal emails to neurology consultants. The quality of referrals from the ED had a knock-on effect on how follow-up clinics are organised and triaged by neurologists who have not seen the patient and may rely solely on ED documentation. In the absence of a local streamlined pathway, the patients with suspected seizures presenting to the ED had problems accessing the appropriate care, thus being at risk to loss to follow-up.

Scope

The particular cohort of interest for this QI are adults (aged 16 years or more) presenting to the ED with the provisional diagnosis of epileptic seizure (first fit). However, at the outset, it is diagnostically challenging to establish the aforesaid diagnosis with certainty in the ED. A patient referred to the first fit clinic, thought to have a provisional diagnosis of epileptic seizure (first fit) in the ED(7), may have an alternative diagnosis (e.g. PNES or neurocardiogenic syncope)(8) after the diagnostic refinement and verification process(9). Therefore, the authors have decided to adopt the term “suspected seizures” as it more accurately encompasses the target group described.

1.3 Available Knowledge

One of the authors (EH) conducted a literature search prior to the implementation of the QI project to inform local guidelines for patients presenting to the ED with suspected seizures. Particular themes of interest were: i) criteria for an urgent CT head in the ED; ii) mandatory investigations from the ED (bedside and biochemical); iii) discharge and admission criteria; and iv) information required by the neurologists to effectively triage the ED referrals. This process aimed to improve

communication between the ED and neurology team by reducing work duplication and reduce wastage.

The MEDLINE database was searched for the relevant literature (January 2013 to January 2018). Boolean keywords used were: “((first fit referral pathway) OR (seizure AND referral) AND (emergency)”. The search strategy returned 45 results. Out of the 47 results, 11 articles were deemed as relevant. Three articles from relevant grey literature were identified: a) The National Institute for Health and Care Excellence guidelines 137: Epilepsies diagnosis and management(13) , b) The Royal College of Emergency Medicine(UK) local guidelines webpage: First seizure in adults(14); and c) Best practice guidance for the management of first seizures in the ED (Turner and Bengner, 2009)(15).

Patients presenting with a suspected seizure and who are well at the moment of review do not require a CT head from the ED if reliable follow-up can be ensured (15).The indications for an urgent CT head(14) from the ED include: age more than 60 years(16), recurrent seizures (i.e post-initial assessment of first seizure), focal neurology, signs of raised intracranial pressure or an immunocompromised individual. Magnetic resonance imaging (MRI) of the brain is the imaging modality of choice(15). The MYHT does not have adequate facilities to provide immediate MRI scans 24/7, and therefore CT scans were decided as the first-line brain imaging modality.

ED management goals should focus on excluding life-threatening pathologies and seizure mimics prior to referring patients for onward care. Therefore, the local guidelines incorporated mandatory investigations that needed to be performed in the ED to rule out common seizure mimics, such as: capillary blood glucose to rule out hypoglycaemia (17); electrolyte profile including serum calcium to rule out electrolyte imbalance(18); electrocardiograms to rule out cardiogenic seizures; and a pregnancy test in women of childbearing age(19) to rule out eclampsia. Routine testing of serum

magnesium levels in known healthy individuals was not conducted (17) to reduce wastage. The importance of accurate history taking and adequate physical examination(20) in differentiating between suspected seizure types (e.g. PNES and cardiac causes) was highlighted, along with particular features that differentiate each variant (epileptic versus non epileptic) (14, 17, 18). Routine requesting of EEG's from the ED was not conducted due to high false positive rates (21). Patients referred to the first fit clinic from the ED ideally should be seen within 14 days as stipulated by NICE(13).

The local guidelines went through rigorous internal quality control reviews (clinical governance meetings and inter-speciality meetings) before being approved for use.

1.4 Rationale

The information in the diagram (Figure 1) was derived from the local audits, interviews with stakeholders, formal and informal meetings and online surveys.

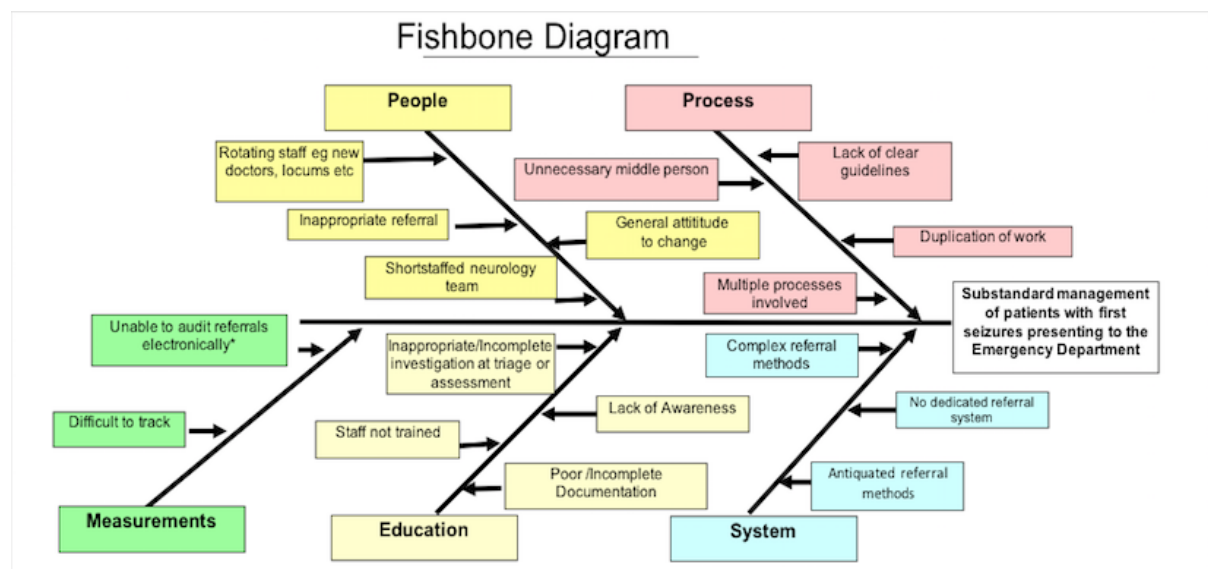


Fig 1. Ishikawa cause-effect diagram

Stakeholders

The defined stakeholders involved in the project were from the following groups:

- 1) ED, division of medicine—clinicians and nursing staff
- 2) Neurology department, division of medicine—clinicians and secretaries
- 3) Information technology services
- 4) Appointment and bookings team
- 5) The patient

Process Mapping

The patient's journey from the point of booking at the ED reception until review at the first-fit clinic is depicted in Figure 2.

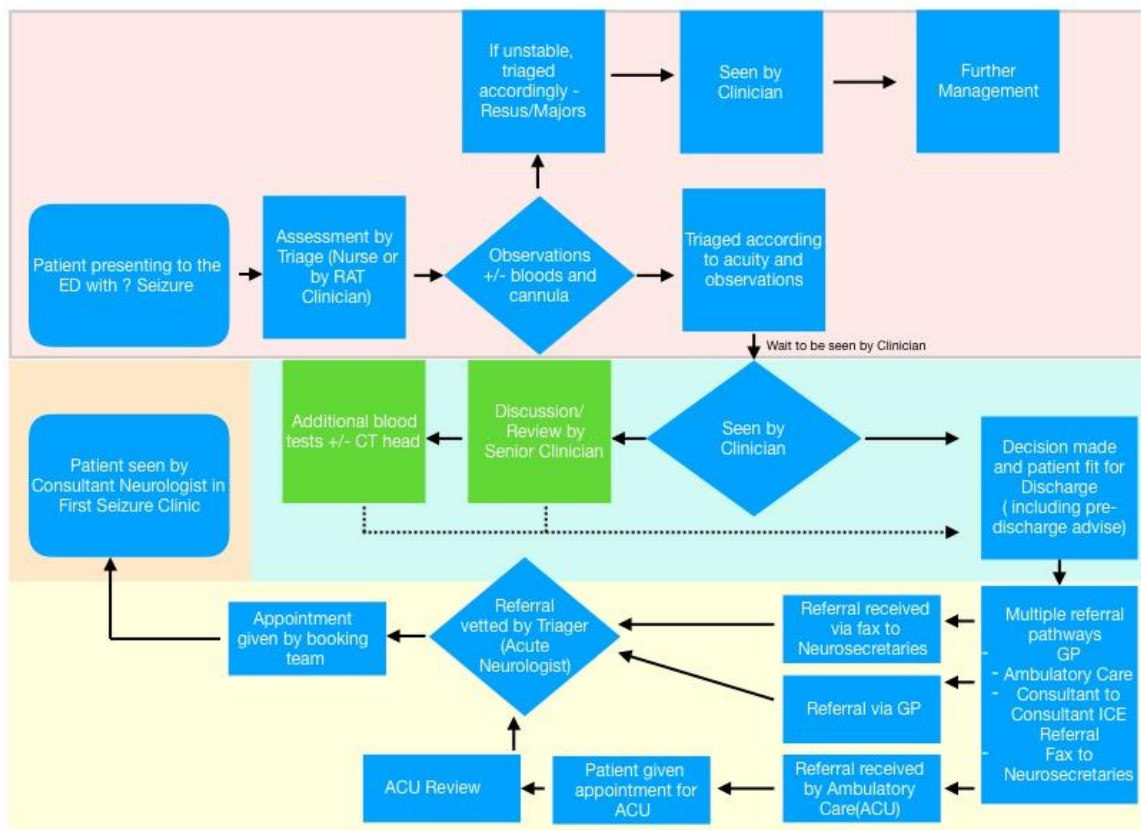


Figure 2. Process map of the patient journey

Cost Analysis

The average cost per ED attendance for a patient with suspected seizures is GBP123 (25). This incurs an average local cost of GBP408 360 (GBP123 x 3320 attendances) per year (2020). The actual cost may be significantly higher as the estimate does not include the cost of an ambulance call out (GBP252), which usually occurs for the mentioned cohort of patients (1). The NIHR Investigation and Intervention Interactive Costing tool (iCT)(26) was used to guide cost estimation per patient for: overnight hospital stay/ward admission (GBP412) , Ambulatory Care Unit admission(GBP207) and performing a non-contrast CT head (GBP247) with reporting (GBP113). A patient with suspected seizures brought in by ambulance to the ED who is subsequently referred onwards for medical admission overnight is estimated to cost a minimum of GBP1147 per patient. A similar patient subsequently referred to the ambulatory care unit is estimated to cost a minimum of GBP942 per patient.

Aims

The aims of this QI project were as follows:

- 1) Patient outcomes: To improve the management of patients with suspected first seizures presenting to the ED by developing and implementing a streamlined protocol.
- 2) Auditability: To ensure auditability of all referrals from the ED to improve the triage process by the neurologists. Auditable referrals reduce the chance of loss to follow-up and provide a feedback pathway for rejected referrals.
- 3) Wastage reduction: 0% rejection rate of the referrals from the ED due to insufficient information.

- 4) Wastage reduction: No referrals (0%) to the ACU from the ED for patients with suspected seizures suitable for the first fit clinic. Referral to the ACU offered no additional benefit to the patient as they will be referred to the first fit clinic.
- 5) Statistical outcomes : To demonstrate a stable and sustainable process statistically using the rules defined in the NHS Institute for Innovation and Improvement(27).

2. Methods

Quality improvement methodology

The Model for Improvement by the Institute of Healthcare Improvement (IHI)(28) was chosen as the methodology for this project. The IHI model provided a straightforward and focused framework to address the highlighted issues and to accelerate improvement . Changes were carried out in small steps within an “overarching aim with a longitudinal measurement process”(29). The PDSA cycle (Plan – Do – Study – Act) is a tool used as part of the model to rapidly introduce changes sequentially and to test their outcome. Each cycle allowed the team to learn from the mistakes and consequentially, a new cycle is redesigned to improve on the previous one. Even though not part of the IHI Model for improvement methodology, this QI project also incorporated Taiichi Ohno’s lean thinking approach(30). Unnecessary investigations, redundant processes (duplication of work, referral to ACU), underutilization of staff knowledge and prolonged waiting times were considered as “wastes”(30). A “waste” is as any step or action in the process (Figure 2) which does not any value to the patient’s journey(31). The interventions in each PDSA cycle were directed towards waste reduction through small-scale changes.

Change management methodology

A collaborative approach in establishing an integrated referral pathway for patients with suspected seizures from the ED (32) is the best way forward. The authors have chosen Lewin's change management model(33) to inform stakeholder interaction. Lewin postulated a three-phase model to provoke change in an organisation; unfreeze, change, refreeze. In the first phase (**unfreeze**), we convinced the stakeholders that there was indeed dissonance in care towards patients presenting with suspected seizures to the ED through data collection and data sharing.

The next phase (**change**), was the most challenging phase. In a large organisation with multiple stakeholders, transformational change is not often assimilated easily(34).Therefore, the core component of the phase involved action research(35), where a democratic-participative approach is used to identify issues and collaboratively reach a mutual understanding. The aim was to avoid forceful, authoritative change as the impact would less likely be deep-rooted. For example, regular meetings were held between the stakeholders to raise concerns and issues arising from the change. Mediators were used to negotiate a solution until the desired outcome was achieved. The final phase of the change process was **refreeze**. This phase ensured the sustainability and stability of the processes after the implementation of change. Here teaching and training played an important role, as the ED often had new rotating clinicians and nursing staff.

The Standards for Quality Improvement Reporting Excellence(SQUIRE 2.0) reporting guidelines(36) was used to present this report.

2.1 Forming the Team

A team was formed with members from the ED (EH and SR), with input from the neurology team, members from the appointments booking team, IT department, Acute Medical team and managerial representatives from the stakeholders.

2.2 Establishing Measures

Outcome Measures

The outcome measure was the **waiting time to be seen in the first-fit clinic upon discharge from the ED**. The waiting times are an important key performance indicator that reflects on the performance of all the departments (ED, neurology, bookings), either directly or indirectly. In addition, it is a patient-centric measure.

Process Measures

The defined process measures for the project were as follows: Process measures where documentation of; a) alcohol intake, b) full neurological examination, c) driving advice and d) ED senior involvement.

Omission of any of the information above resulted in the rejection of referrals and delayed access to neurology clinics.

Balance Measures

To ensure that the measures introduced did not negatively impact other services, the balance measures were a) number of referrals to the ACU and b) number of rejected referrals

2.3 Interventions and Implementations

Changes in each cycle were implemented according to the IHI Improvement Model's PDSA format.

The changes in each PDSA cycle and the issues arising within each cycle are described in Appendix A.

Since 2019, there were a number of audits conducted and some staff educational interventions.

These interventions were regarded as part of the sustainability process and not as an individual PDSA cycle on their own.

Changes were communicated through trust communication emails, departmental memos, word of mouth during clinician handovers, departmental posters and educational sessions (junior doctor induction, nursing triage courses, etc.)

3. Data Collection and Analysis

Data Collection

Waiting times (in days) from date of ED attendance to date of first clinic appointment were obtained for all patients presenting at the ED over a three-year period from 6 January 2018 until 31 December 2020, including data points collected both before and after the intervention. The data were collected in batches by three different doctors individually over the period and then collated by one of the study authors (EH). A dedicated proforma was used to reduce variation. The data from the audit was shared with the key stakeholder (neurology department) for third-party corroboration. Collated data were sent to an independent statistician (JS) for further analysis.

Statistical Analysis

All statistical analysis were conducted using IBM SPSS Statistics for Windows version 26(IBM Corp., Armonk,N.Y.,USA). Parallel analyses were conducted on ungrouped data and on data grouped and averaged in units of calendar months. Waiting times were summarised for both sets of measures. With right-skewness expected in the distribution of waiting time measures, several data transformations were investigated to achieve normality of distributions, with the logarithmic transformation found to be the most effective in normalizing data. Analysis proceeded on log-transformed data values.

A Shewhart X control chart was constructed from log-transformed ungrouped data. A Shewhart X-bar control chart was constructed from log-transformed data, grouped by calendar month. Control limits were set at ± 3 sigma for both charts. A lower specification limit of 14 days, corresponding to the NICE recommendation for minimum waiting times, was set on both charts. Upper specification limits were not set. Exceeding the upper control limit, 8 consecutive points above the centre line and 6 consecutive points trending upwards were proscribed control rules. For all charts, the extent of violations before and after the introduction of the intervention at the end of 2018 was compared.

4. Results

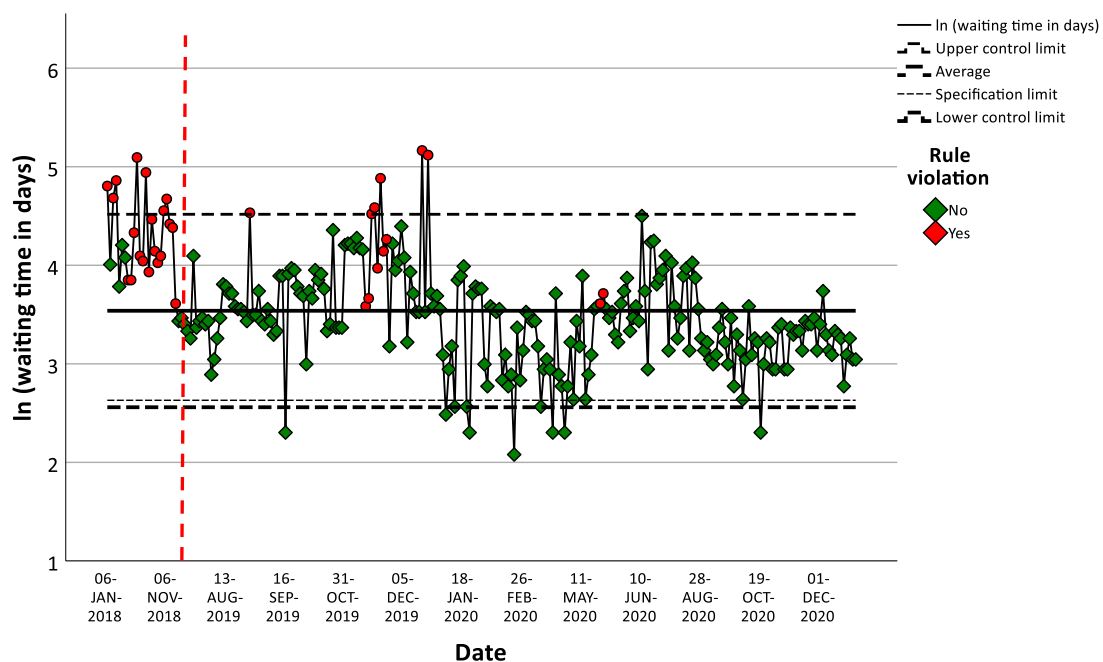
4.1 Ungrouped Data

Individual waiting times were recorded from January 2018 to December 2020. The mean (median) waiting time pre-intervention implementation was 78.9 days (65.0 days), with an SD of 33.6 days and a range of 37 days to 163 days). The mean (median) waiting time post-intervention implementation was 36.2 days (31.0 days), with an SD 21.7 days and a range of 8 days to 175 days).

Using log-transformed data, the reduction in daily waiting time following the introduction of the intervention was statistically significant at the 5% significance level ($t_{30,9}=9.42$; $p<0.001$).

The Shewhart X-chart for ungrouped data is illustrated in Figure 3. Process violations are indicated by red circles; points within the process are indicated by green diamonds. The introduction of the intervention is denoted by a red dotted line. The upper control limit on the log scale was 4.52.

Figure 3: Shewhart X-chart: Log-transformed waiting times (ungrouped data)



Prior to the introduction of the intervention, 18 out of 24 points represented process violations (75.0%). Post-intervention, 12 out of 243 points (4.94%) represented process violations.

The process exhibited good control levels throughout most of the post-intervention period, with most points varying randomly around the centre line. This contrasts clearly with the behaviour prior to the implementation of the intervention.

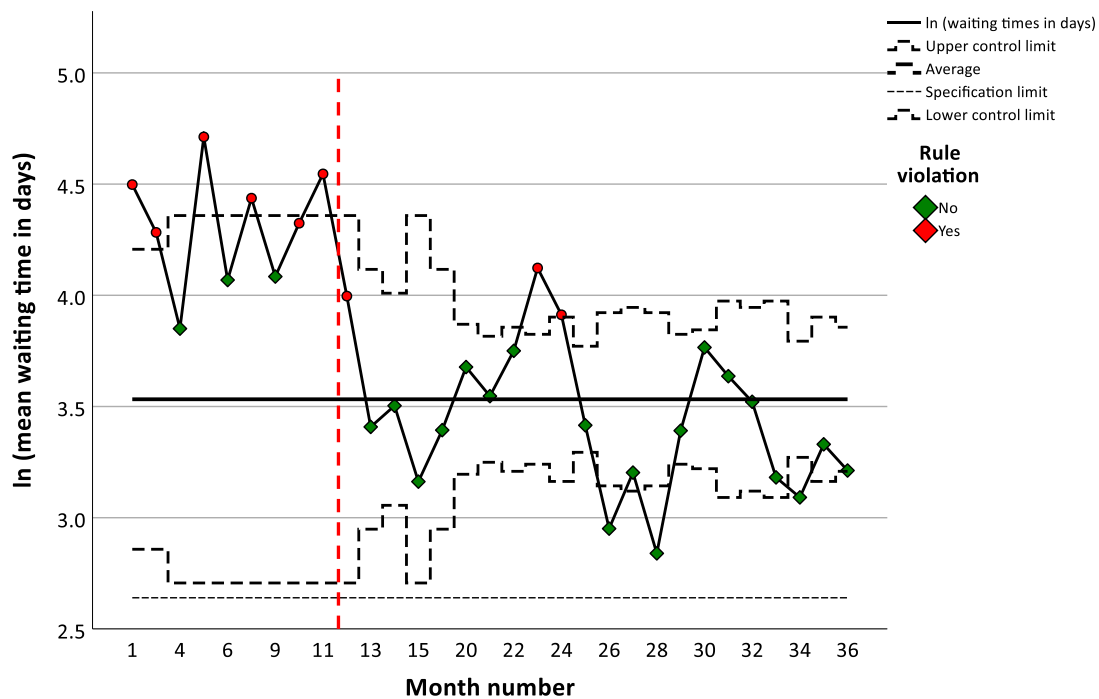
4.2 Grouped Data

Mean monthly waiting times were evaluated from January 2018 to December 2020. No data points were recorded in three months of the 36-month analysis period. In the 33 months when data was recorded, between 1 and 26 data points were recorded.

The mean (median) monthly waiting time pre-intervention implementation was 77.7 days (78.8 days), with an SD of 21.6 days and range of 47 days to 119.5 days. The mean (median) monthly waiting time post-intervention implementation was 34.6 days (31.1 days), with an SD of 12.2 days and range 18.8 days to 66.4 days). Using log-transformed data, the reduction in daily waiting time following the introduction of the intervention was statistically significant at the 5% significance level ($t_{26,3}=7.60$; $p<0.001$).

The X-bar chart is illustrated in Figure 4 below. The introduction of the intervention is denoted by a red dotted line. Plotted points represent the averages of the measurements within each subgroup. The centre line represents the average of the plotted points (i.e., the process mean). Month number 1 corresponds to January 2018 and month number 36 corresponds to December 2020.

Figure 4: Shewhart X-bar chart: Log-transformed waiting times (data grouped by month)



Prior to the introduction of the intervention, 5 out of 8 points represented process violations (62.5%). Post-intervention, 3 out of 22 points (13.6%) represented process violations. Some months during the analysis period were omitted due to a lack of data.

4.3 Measures

Auditing the proportion of rejected referrals from the ED pre-intervention was technically difficult, as multiple pathways existed. In addition, a robust referral rejection processes was lacking. After the intervention period, there was a 4% (10 out of 243) rejection rate of referrals from the ED by the neurology services. Most of these referrals were rejected based on patients being referred from outside the catchment area for service provision ,not due to poor documentation.

Process measures (documentation-related descriptors) were met with 100% compliance. Pre-intervention period 12 out of 24 (50%) cases were referred from the ED to the ACU. There were no referrals made to the ACU after the intervention period.

5. Discussion

The QI has met with the key aims described. The waiting times from ED discharge to the first-fit clinic significantly improved after the interventions despite not meeting NICE's recommended waiting time. The MYHT has a limited number of neurologists. Any further efforts to reduce the first fit clinic wait times might be detrimental to the wider service provision responsibilities of the neurology team.

Patient outcomes and auditability

Through the introduction of an electronic referral process, neurology services have been able to appropriately triage referrals according to the level of urgency, based on the information provided by the ED team. The process is now easily auditable and allows prompt targeted feedback. This was felt to be a key achievement, as streamlined information sharing provided the means for adequate triage and risk stratification of patients. Important neurological examinations, such as alcohol intake and driving advice, were documented consistently; therefore, the audit cycle loop was closed(37).

The special cause variations that were identified from October 2019 to January 2020 were attributable to the change in service provision in preparation for the COVID-19 pandemic. Most face-to-face clinic appointments were suspended at that period and the trust was in a transitional phase

to provide video clinic consultations. Other special cause variations (or near violations) were due to the clash in clinic appointments, as some of the patients were requiring other clinic appointments that needed to be prioritized (for example, cancer clinic appointments). In cases of rejected referrals, the clinician (referrer) would be informed of the rejection and a letter would be sent out to the patient's GP. The scenario provided a tight "safety net" for patients who were felt by the neurologists not to require a first seizure clinic but needed further workup through their primary care physician.

Statistical assessment

The collated data and analysis of the retrospective data (three-year period) demonstrate that the QI project is sustainable, stable and preserves patient safety. The proportion of process violations reduced substantially following the implementation of the intervention; assessed using either grouped or ungrouped data, and the reduction in waiting times following the implementation of the intervention was statistically significant at the 5% significance level.

Wastage reduction

Cost savings for the trust per patient seen is inferred as a result of demonstrated adherence to the local guidelines. Due to the technical and fundamental limitations in measuring the related wastage (inappropriate CT's and hospital admissions), the cost impact of this QI project was calculated based on the number of avoided referrals to the ACU from the ED. We estimate that this QI project has potentially saved the MYHT a minimum of GBP24,116 (233 x GBP207 x 50% referral rate) through the cessation of ACU referrals from the ED over the three-year period (beginning 2018 - 2020 end).

Limitations

This QI project has failed to meet NICE's standard of 14-day clinic wait time. The project was conducted in a single trust (comprising three different hospitals) in the West Yorkshire region, UK. The principles that have been used for change management may be generalized, but factors such as type of patient cohort, difference in organisational structure and local protocols may have a significant impact on the outcomes. Collection of data in phases by different individual doctors, third-party corroboration of data and independent statistical analysis were measures used to mitigate researcher bias. Other measures such as the number of inappropriate investigations done, could have been considered; however, some of these descriptors would rely heavily on subjective assessment. Patient feedback was not collected due to confidentiality considerations. Ideally, time to be seen in other neurology clinics after the introduction of the referral pathway could have been measured to assess the impact of the interventions to provide a more comprehensive evaluation of the project.

6. Conclusion

Implementation of the interventions resulted in clear improvement in the process controls as seen in the Shewhart charts (grouped and ungrouped). In this QI project, a straightforward methodology, both in healthcare improvement (the IHI method) and change management (Lewin's model), was used with favourable outcomes. Change in a large organisation would require a collaborative approach using action guided by research to improve stakeholder buy-in. Improvement efforts are considered a work in progress, as the change in circumstances necessitates re-education of staff to ensure compliance. Future work should continue to focus on novel methods for improving waiting

times to align with NICE's guidelines (14 days). Further projects should consider patient response and satisfaction surveys, subject to ethical approval.

Funding

This QI project received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Ethics

Ethical approval is not required for this project, as it is classified as service evaluation by the Health Research Authority, National Health Service, UK.

Authors' Contributions

EH conceived, designed, planned and led the QI project. SR was involved in planning the QI project and supervision of the work. JS analysed the data statistically and contributed to the results section of the manuscript. EH drafted the manuscript with contributions from SR and JS. All authors discussed the results and approved the final manuscript.

Competing Interests

None declared.

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The Emergency Department Team, Mid Yorkshire NHS Hospitals, UK

The Appointment and Bookings Team (ABC), Mid Yorkshire NHS Hospitals, UK

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