ELECTROENCEPHALOGRAPHY REFERRALS AND OUTCOMES IN A TERTIARY PSYCHIATRIC HOSPITAL

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine in the branch of Psychiatry

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DECLARATION

I, Molokashe Meriam Molokomme declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in the branch of Psychiatry in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

M M Molokome

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13th day of August, 2012

DEDICATION

For my loving parents, siblings and my dearest son Thabiso.

PUBLICATIONS AND PRESENTATIONS ARISING FROM THIS STUDY

Preliminary findings of this research report were presented during the Psychiatry Research day 2010, held at the University of the Witwatersrand.

ABSTRACT

INTRODUCTION

The electroencephalography (EEG), since its inception in the 1930s, has become one of the most used investigative tools in psychiatry. Its uses include exclusion of seizure disorders and encephalopathic conditions. In psychiatry distinguishing between a primary psychiatric disorder and psychiatric manifestations of an underlying medical condition is of vital importance. This determines which course of management the psychiatrist should follow, and most importantly, determines the prognosis.

However, EEG studies done in psychiatry have yielded unfavourable results. The yield of positive (abnormal) EEG results is very low. Despite this, it is still widely requested by most psychiatrists.

There is a dearth of literature assessing the usefulness of EEG in psychiatry in our South African setting. The current study looked at which users are referred for EEG and the outcomes thereof.

METHODS

The study was conducted at Sterkfontein psychiatric hospital. A retrospective review of clinical records, and EEG reports, of inpatients 18yrs and older that underwent EEG between January 2008 to June 2009 was done. A data sheet was used as a recording tool. Data was analysed using the Statistica 9.0 system.

RESULTS

The total sample was 85. Seventy four (87%) records were normal, 7(8,2%) were abnormal, 2(2,4%) were inconclusive and two EEG reports were unavailable. Only one user's diagnosis changed based on abnormal EEG results. There was no statistically significant correlation between abnormal EEG results and demographic variables, symptoms, admission diagnosis and medications.

CONCLUSION

The positive yield of EEG results remains very low in psychiatry. EEG results do not appear to influence the treating psychiatrist's decision regarding management.

ACKNOWLEDGEMENTS

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The EEG (electroencephalography) has become established as one of the principal investigative tools of cerebral function based on the work by Hans Berger in the 1930s.[1] Hans Berger was the discoverer of brain waves. Through his mentor, Karl Langenstrass, M.D., who had trained at the University of Jena under Hans Berger, Robert Cohn established an EEG laboratory and built his own EEG machine at St. Elizabeth's Hospital in Washington, D.C.[2] The EEG has been in use worldwide since then.

The EEG is a recording of the electrical potential activity of the brain. It is a non-invasive, low cost, neurodiagnostic technique widely available in general and psychiatric hospitals in South Africa.[3]

1.1.1 Uses of EEG

EEG is mainly used to detect seizure activity in the brain. It is also used for detection of possible organic aetiologies such as metabolic encephalopathies and tumors. EEG also plays a major role in polysomnography studies. The wave patterns seen on EEG during polysomnography indicate the sleep stage. Other uses include monitoring the success of the stimulus in producing seizure activity during electroconvulsive therapy (ECT).[4]

The EEG has a role in detecting presence of complex partial seizures (TLE- temporal lobe epilepsy). TLE has several symptoms which may be considered 'psychiatric'. These include

perceptual disturbances such as visual, olfactory and tactile hallucinations in the pre-ictal phase; episodes of brief disorganized behaviour in the ictal phase; confusion and amnesia of the ictal phase in the post-ictal phase and psychotic symptoms, mood symptoms, episodic violence and personality disturbances in the interictal phase.[4]

A patient with an acute episode of schizophrenia may present with hallucinations, as well as disorganised and violent behaviour. Episodic mood changes such as irritability and depression that interfere with functioning may indicate the presence of a bipolar disorder.[4]

A significant association exists between the presence of an organic factor in the history, mental status examination, or physical examination and the yield of abnormal EEG's.[5]

1.1.2 EEG recording

The electrodes normally used to record the EEG are attached to the scalp with a conductive paste. The EEG must be recorded with the patient as motionless as possible, to eliminate the introduction of muscle artefact. Hyperventilation, photic stimulation and sleep deprivation increase the likelihood of picking up a positive result. A normal EEG consists of a mixture of frequencies, which are divided into four bandwidths. Delta waves oscillate below 4Hz, theta waves from 4-8Hz; activity below 8Hz is also called slow wave activity. Alpha waves, the frequency of the posterior dominant rhythm, are from 8-13Hz, beta waves are over 13Hz (fast activity). Normal activity consists of posterior alpha rhythm with the eyes closed; more anterior regions have random admixtures of theta, alpha, or beta activity.[4]

1.1.3 Abnormal EEG patterns

Several wave patterns as seen on an EEG recording can suggest pathologies such as the three per second spike-and-wave considered a characteristic of petit mal epilepsy. Dementia is associated with excessive slow wave activity on EEG, whereas depression tends to show a normal recording, thus EEG can be useful in differentiating between dementia and pseudodementia seen in depressed patients. In delirium, the EEG characteristically shows a generalized slowing of activity. Low voltage fast activity is the pattern more likely to be seen in agitated disorganized patients who are more likely to be identified as 'psychiatric'.[6]

In comparison to non-schizophrenic patients, schizophrenic patients tend to show more beta and theta activity on the EEG which are not treatment related. First episode and chronic schizophrenia patients show similar EEG changes which suggest that this is characteristic of the condition rather than duration of the illness and exposure to medications.[7]

Psychotropic medications can result in changes in the normal EEG pattern. Low voltage fast activity can be induced by benzodiazepines. EEG abnormalities are also seen in patients who are on antipsychotic treatment, with risk being particularly high with clozapine and olanzapine, moderate with risperidone and typical neuroleptics, and low with quetiapine. Severe EEG abnormalities i.e. spike discharges or spike-and-wave abnormality, have been associated with olanzapine, chlorpromazine and clozapine.[8]

1.1.4 EEG limitations

A normal recording does not necessarily exclude pathology. Serial EEGs may have to be done to increase the possibility of a positive finding, which increases the cost of a patient's workup.[6] Only 20%-50% of epileptic patients show interictal epileptiform discharges, which are associated with a clinical seizure disorder, on their first routine EEG.[9]

EEG abnormalities are largely non-specific. An EEG has a low spatial resolution but a high temporal resolution. This implies that it can detect changes in neuronal function in milliseconds time frame in comparison to other brain function tests such as functional magnetic resonance imaging which reflects changes in seconds' time frame.[10] The electrical potential of multiple neurons with similar spatial orientation is recorded on EEG. However, since the current falls off, scalp EEG may not reflect changes in deeper lying structures.[11] Slow growing lesions may not cause many EEG changes, particularly if the lesions are small and not located near the cortex.[6]

Deep or medial temporal lobe epileptiform discharges may require use of sphenoidal or nasopharyngeal electrodes which are invasive and bothersome to patients.[6]

There is also a concern that some clinicians order EEGs as part of practising 'defensive medicine' to avoid litigations. This may contribute in part to increased frequency of negative EEGs.[1]

It is in view of the above limitations that this study was conducted.

1.2 HYPOTHESIS

It is hypothesised that, in the majority of cases, there will be no changes in the clinical management based on the EEG results.

1.3 STUDY AIM

To determine whether EEG findings impact on clinical management.

1.4 STUDY OBJECTIVES

- To investigate the reasons why psychiatric patients are referred for an EEG.
- To determine what abnormalities are reported on the sample population.
- To determine which psychiatric signs and symptoms are correlated with a positive EEG.

CHAPTER 2: LITERATURE REVIEW

Only a few studies have been done in South Africa and other African countries to assess the usefulness of EEG in psychiatry; while several studies have been done in other continents.

2.1 AFRICAN LITERATURE REVIEW

Rascher et al searched for relevant articles on MEDLINE, which were published between 1966 and 2003.[3] The amount of South African data examining either prevalence or usefulness of EEG abnormalities among adult psychiatric patients was limited.

The two South African studies of relevance that were found were done by Stein at Hillbrow hospital in 1991 and Szabo on adolescents at TARA hospital in 1999.[3, 12]

Stein, cited by Rascher et al, analysed all departmental referrals for EEG over a one year period. The inclusion criteria were direct referral by the Department of Psychiatry, overt psychiatric symptomatology and an absence of clinical neurological findings. A total of 145 patients met the inclusion criteria. Seventy one patients were shown to have clearly demonstrable abnormalities on EEG. Thirty five (50%) of these exhibited definite epileptiform activity. Forty eight patients (67%) had localised EEG dysfunction, with twenty-three (47%) of abnormalities being found in the temporal lobe areas. The percentage of abnormal EEG's leading to a change in diagnosis or management was not determined.[3]

Szabo et al, reviewed all admissions to the adolescent inpatient unit at Tara Hospital between 1990 and 1995. Thirty six patients underwent EEG during this period .Close to half

(44%) of the patients received a definite diagnosis of complex partial seizures, based on both clinical features and EEG findings. In the remainder, 34% had nonspecific abnormal EEG's and 22% were normal. Aggression and hallucinations increased the likelihood of a diagnostic EEG, with positive results in 60% of those with aggression and 53% of those with hallucinations. The other clinical features predictive of a diagnostic EEG were mood instability in 33%, dissociative states in 33% and a premorbid organic insult in 26%. The clinical features predictive of an EEG abnormality; but not a change in diagnosis or management; included aggression in 36%, hallucinations in 45% and a premorbid organic insult in 36%.[12]

Rascher et al highlighted that discordance still exists when examining prevalence and usefulness of EEG abnormalities in adult psychiatric patients. It was suggested that a patient be carefully assessed for any clinical evidence of organic disease prior to being referred for EEG, preferably by more than one psychiatrist.[3]

To our knowledge, there have not been any such published South African studies since this review article to date. Two studies of relevance, closer to home, found published on MEDLINE between 2004 and 2009 March were done in Lagos, Nigeria by Aina O F et al.[13, 14]

One study which was prospective in nature was done over twelve months of setting up an EEG unit at a psychiatric hospital in Yaba, Lagos. The inclusion criteria included all patients that had an EEG recording in the unit during the study period. Awake EEG was done on each subject. Seizure disorder constituted the largest clinical reason for EEG request. The EEG findings were normal in close to 44% of the sample and abnormal in 56% with "epileptiform activities" reported as the most common abnormality. The researchers

concluded that EEG continues to be of importance in the management of neuropathological disorders.[13]

The other study was done in children. It looked at neuropsychiatric correlates and EEG findings among children with developmental disorders. A clinical evaluation was made to reach a diagnosis, and a waking EEG was performed. The recordings were done by an EEG technologist blinded to the clinical diagnosis of the subjects. EEG interpretation was done independently by two psychiatrists trained on EEG interpretation. In a sample of 111 individuals; EEG abnormalities were picked up in 85(76,6%) individuals. In this study there was no significant correlation between the EEG abnormalities and the developmental disorder diagnosed. However a number of the subjects also suffered from seizure disorders and hyperactivity related to the developmental disorder.[14]

2.2 INTERNATIONAL LITERATURE REVIEW

Warner et al reviewed 190 EEG recordings and charts of psychiatric inpatients at the University of Texas Harris County Psychiatric Center. Usefulness of screening EEGs, which was defined as EEG results leading to a change in diagnosis and treatment, was assessed. Of the 190 charts reviewed, 115 patients (61%) had routine screening EEGs. Thirty six (31%) of these screens led to an abnormal recording, however only two (1, 7%) led to a change in diagnosis. Also of significance was that abnormal EEGs were noted more in patients on psychotropic medications ($p<0.006$). The usefulness of EEG as a screening test could not be clearly established based on their results due to the limitations of the retrospective nature of the study.[15]

Boutros et al examined journal articles through MEDLINE search for a 45-year period in 1992 and book chapters that relate EEG to the practice of clinical psychiatry. The authors concluded that the value of the routine clinical EEG in psychiatry lies in its noninvasive nature, low cost, and easy availability. The authors also suggested that EEG should be used in conjunction with other neuroimaging techniques such as CT scan and MRI.[6]

A total of 91 EEG records were reviewed by Fenton et al. These were newly referred patients over a 12month period. Forty (44%) of the records were normal, 17(19%) anomalous and 34(37%) were abnormal. “Anomalous” referred to records with an excess of slower background features or minor paroxysmal phenomena of non-specific significance while abnormal ratings were given to those with an unequivocal evidence of organic brain dysfunction or epileptiform activity. EEG changes due to psychotropic medications were noted in 12 records (13%). Of note was that analysis of the case records revealed that no patient manifested clinically convincing complex partial seizures, although suspected TLE was reason for referral in a third (32%) of all patients. The authors concluded that the EEG abnormality yield is greatest when the clinical history, physical and psychiatric examinations reveal a definite organic mental state phenomena and/or abnormal CNS signs.[16]

In another study by Bowie et al, 76 patients were subjected to a total of 89 EEGs. The abnormal recordings were divided into those which were definitely abnormal and those which were equivocal. Of the 76 patients, 11(14,5%) had definitely abnormal EEGs and 11(14,5%) had equivocal abnormal recordings. The study also showed that the referring psychiatrist could predict whether or not the recording would be abnormal ($p<0,05$). EEG results led to a change in management in 10 cases (13,2%). The authors as in other studies mentioned above also found that there is a reliable association between abnormal EEG

recordings and organic factors in the history, mental state and neurological examination. The authors also highlighted that the clinical value of the EEG is reflected not by the proportion of abnormal recordings but by the influence of the recordings on the patient's management, diagnosis and prognosis.[17]

Lam et al reviewed EEGs of 150 patients. In this study EEG changes due to medications were considered normal. Abnormal recordings were found in 11,3% of the cases. The presence of an organic factor on history, mental status examination and physical examination were more likely to yield positive results. The routine use of EEG for psychiatric patients (as well as other patients) without any presenting organic factors was discouraged by the authors because of the low yield, and negligible clinical significance of normal and abnormal results.[5]

A study by Puri et al in a mental handicap population revealed 37 abnormal EEG recordings in 80 of the patients. The abnormal recording did not lead to a change in management in more than half (23) of the abnormal EEG cases, while in nine cases a change in management followed a report of a normal EEG.[18]

Stone et al reported that "many doctors like to routinely order an EEG as part of a diagnostic work-up for patients with psychiatric disorders". The authors studied 187 EEGs. In 71%, the request was to look for evidence of epilepsy, and in 22% it was to determine the presence of organic brain dysfunction. Only one patient was found to have an unequivocal evidence of an epileptic focus. A 'liability to epilepsy' was found in 11 patients, 10 of whom were being investigated for epilepsy. Of note is that 68 EEG records which showed any of the three patterns; diffuse slowing, diffuse excess of fast activity and temporal dysfunction; were

classified as non-diagnostic .[19] Whether or not a repeat EEG in these 68 patients would have revealed unequivocal evidence of epileptic focus is debatable. The result of only one clear case of an epileptogenic focus was similar to the 0,5%-2% prevalence rate in the normal population as found by Gregory et al.[20]

A more recent study on EEG in psychiatry was done by O' Sullivan et al. A retrospective review of 1470 EEGs was done. The referrals were from several departments including neurology (n=622), psychiatry (n=91) and general medicine (n=490). The reasons for referral from psychiatry and outcomes post EEG were analysed. The proportion of abnormal EEGs detected from psychiatric sources was less than the combined non-psychiatric referred patients, but not to a statistical significance ($p<0.08$). There was no evidence of a significant change in clinical management. The underlying diagnosis remained unchanged in all cases.[1]

The above studies all indicate the limitations of EEG use as a routine screening test. In addition, South Africa's health service is under-resourced due to the country's budgetary constraints. It then becomes important to assess the use of EEG in our own setting.

CHAPTER 3: METHODOLOGY

3.1 SITE OF THE STUDY

The study was conducted at Sterkfontein hospital (SFH). SFH is a tertiary psychiatric hospital with 612 usable beds, and caters for involuntary patients under the Mental Health Care Act no.17 of 2002 (MHCA). It also has a section for forensic patients. Clients are sent by the courts for observation in terms of the Criminal Procedures Act no.51 of 1977 (CPA) to ascertain fitness to stand trial and criminal responsibility. Those who are not fit and/or not criminally responsible are sent back by the courts as state patients in terms of section 42 of the MHCA. Mentally ill prisoners may also be admitted to SFH for treatment, care and rehabilitation as provided for in section 49 of the MHCA.

The hospital was ideal for the study as it is a referral institution. Patients from several other hospitals are referred to SFH for treatment, meaning the sample was representative of the psychiatric population in general. At the time of the study the hospital had 12 psychiatrists and 14 registrars/medical officers.

3.2 STUDY DESIGN

This was a retrospective record review of the patients who were referred for EEG from January 2008 to the end of June 2009. Source data included both EEG reports and clinical records.

3.2.1 Inclusion criteria

Only the records of those admitted to SFH were studied. The sample included adult (age>18) males and females.

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3.2.2 Exclusion criteria

Patients admitted to Leratong hospital, a general hospital nearby, and those from community clinics are referred for EEG study at SFH. Patients who are referred from these facilities for EEG are not all from the psychiatry department. Some are referred from the medical outpatients department. For practical reasons, these patients were excluded from the study.

3.2.3 Data sheet (Appendix 6)

Patient's demographics, multiaxial diagnosis on admission, medications prior to and after EEG, provocation methods used prior and during EEG, EEG findings and any change in diagnosis after EEG, were recorded on a data sheet.

3.2.4 EEG procedure

All users, except for one who had a sleep deprived EEG, underwent a routine non-sleep deprived EEG. Photic stimulation and hyperventilation methods were used during the EEG recordings. All EEGs were done by one technician with the same EEG machine (Neurofax EEG 1000/9000 Version 05-11). All records were reported by one neurologist.

3.2.5 Ethics

The study was approved by both the ethics (Appendix 1) and postgraduate committees (Appendix 2) of the Witwatersrand University, and the hospital's chief executive officer (Appendix 3). An information sheet (Appendix 4) was handed to those who were still inpatients. The researcher also explained in detail the contents of the information sheet. The patients then signed the informed consent document (Appendix 5) provided. All the participants were reassured that their names would not be mentioned anywhere in the study, and the researcher was the only person who approached them regarding the current study. All data sheets were stored in a locked cupboard. A password known only to the researcher was created to access the Microsoft excel sheet where data was captured.

3.2.6 Statistical analysis

Data were analyzed using the Statistica 9.0 statistical program. Results are expressed as frequencies and percentages for categorical variables and as mean±SD for age for the whole group. Age was categorized as: 18-30, 31-49, >50. To assess differences between abnormal results and demographics, symptoms, admission diagnosis and psychotropics, a Chi square test or Fischer's exact test was used. Significance was assumed at a both-sided value of $p < 0.05$.

CHAPTER 4: RESULTS

4.1 SOCIODEMOGRAPHIC PROFILE

The total sample was 85. The majority of the users were male (62,4%), unmarried (83,5%), unemployed(78,8%), and had an education level below grade 12 (72,9%)(Table 1). The mean age was 33.6(SD11.5). Figures 1-5 depict the demographic profiles in graphical representations.

Table 1: Demographics of the sample population

VARIABLE	n (%)
Age: 18-30	43 (50.6)
31-49	30 (35.3)
>50	12 (14.1)
Gender: male	53 (62.4)
female	32 (37.6)
Marital status: married	14 (16.5)
single	71 (83.5)
HLOE: <grade 12	62 (72.9)
>grade 12	22 (25.9) 1 (1.2) unknown
Employment: employed	18 (21.2)
unemployed	67 (78.8)

Figure 1: Sample population age groups

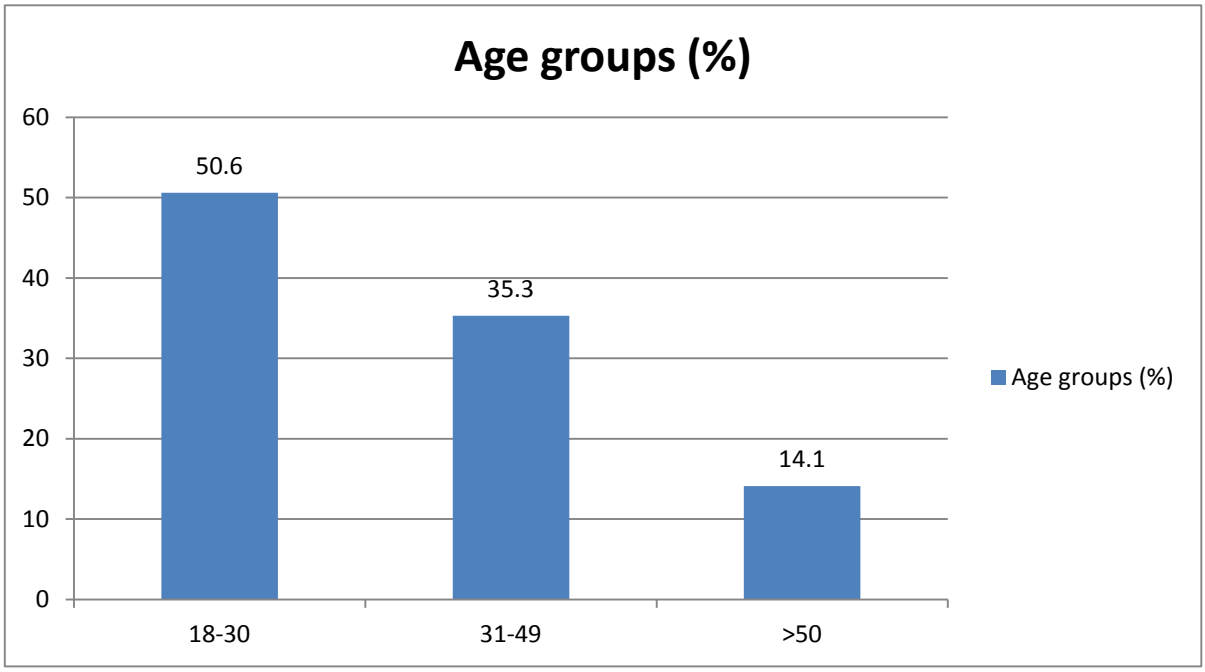


Figure 2: Gender distribution of the sample population

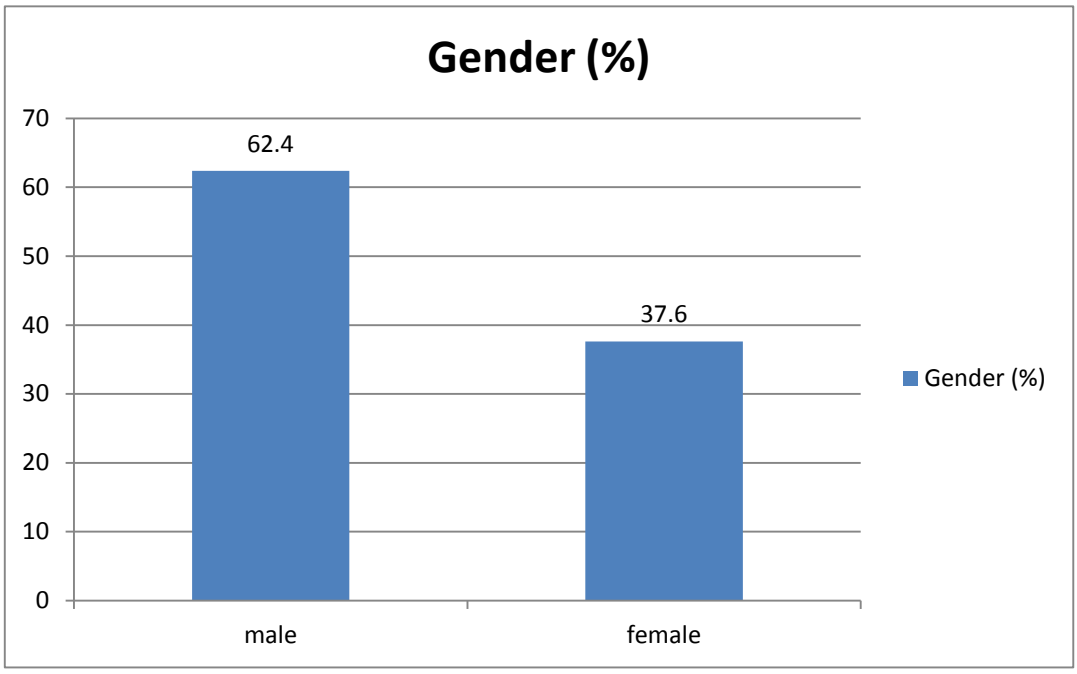


Figure 3: Marital status of the sample population

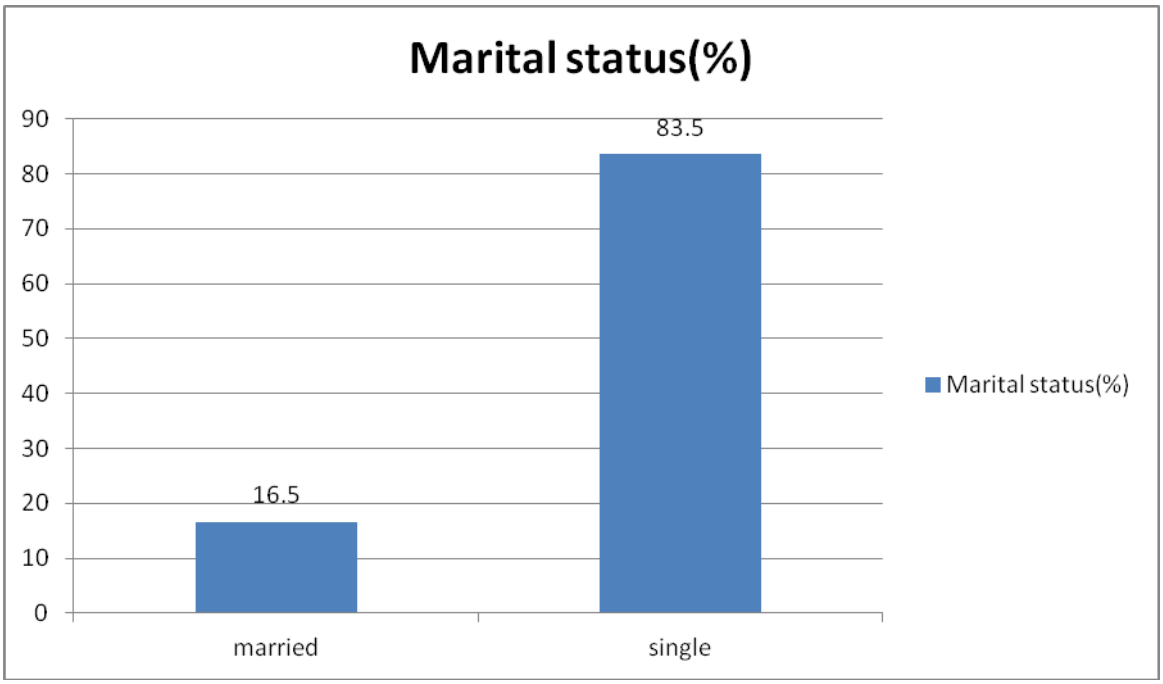


Figure 4: Highest level of education (HLOE) of the sample population

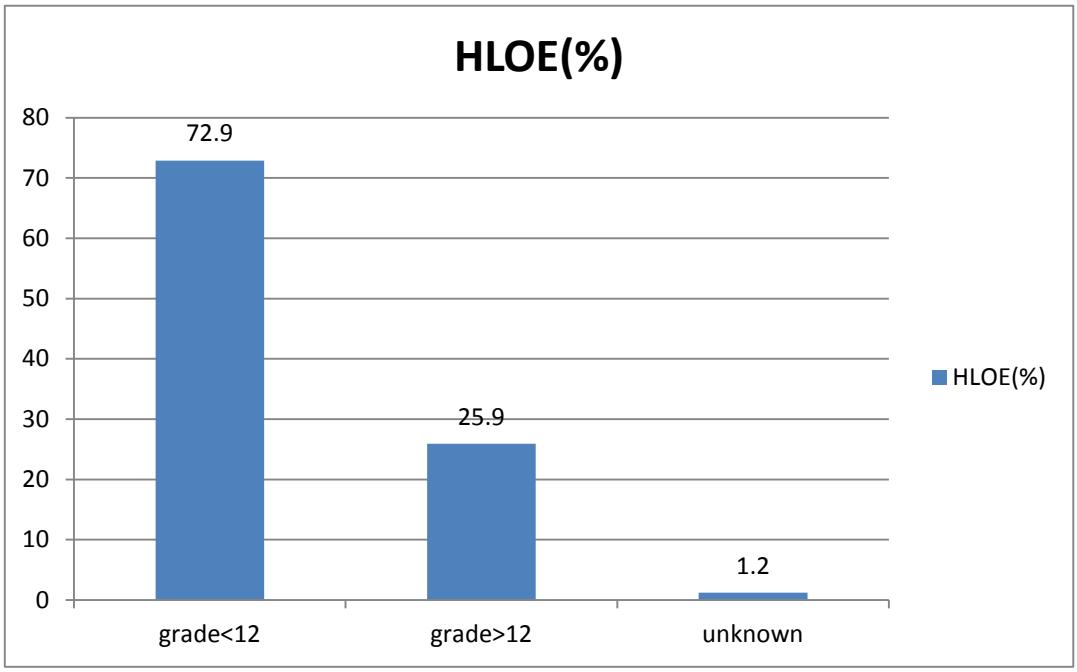
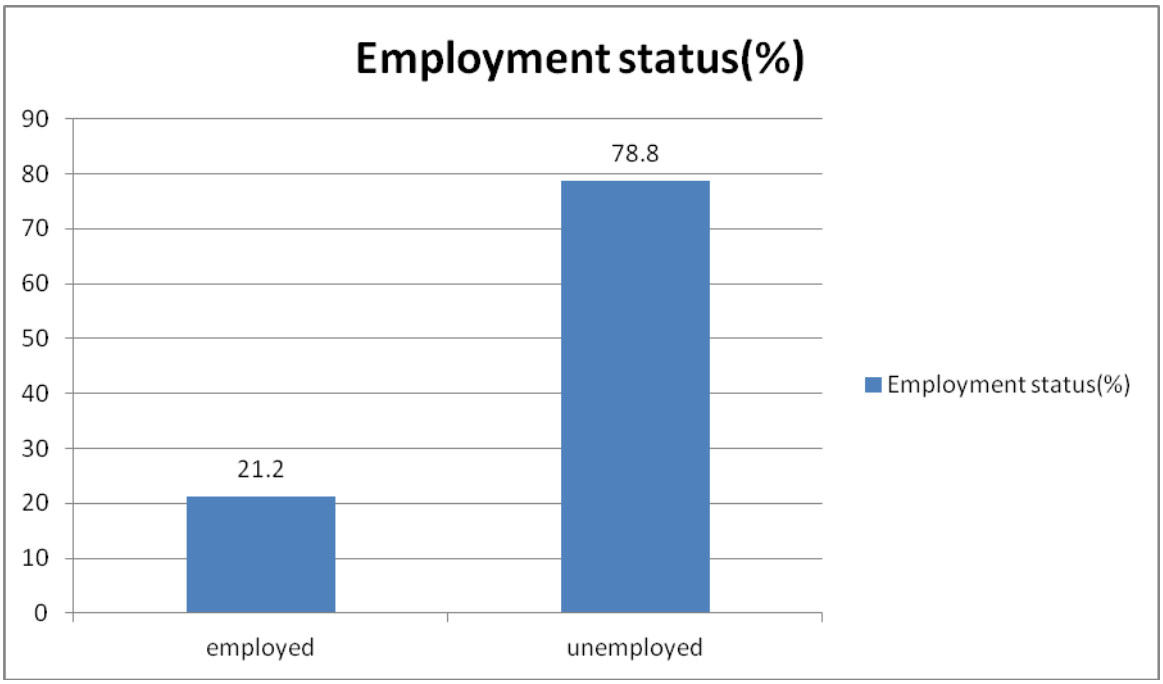


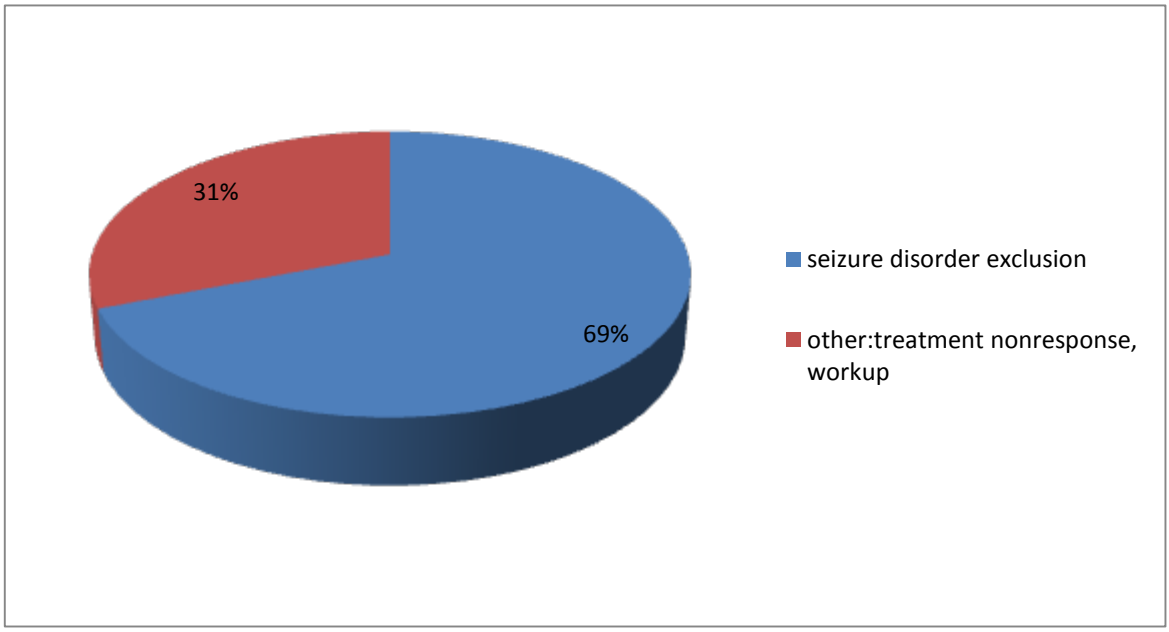
Figure 5: Employment status of the sample population



4.2 REASON FOR REFERRAL TO EEG

As depicted in figure 6, most users (69%) were referred for seizure disorder exclusion and the rest (31%) for other reasons that included treatment non-response and organic workup.

Figure 6: Reason for referral to EEG (sample population)



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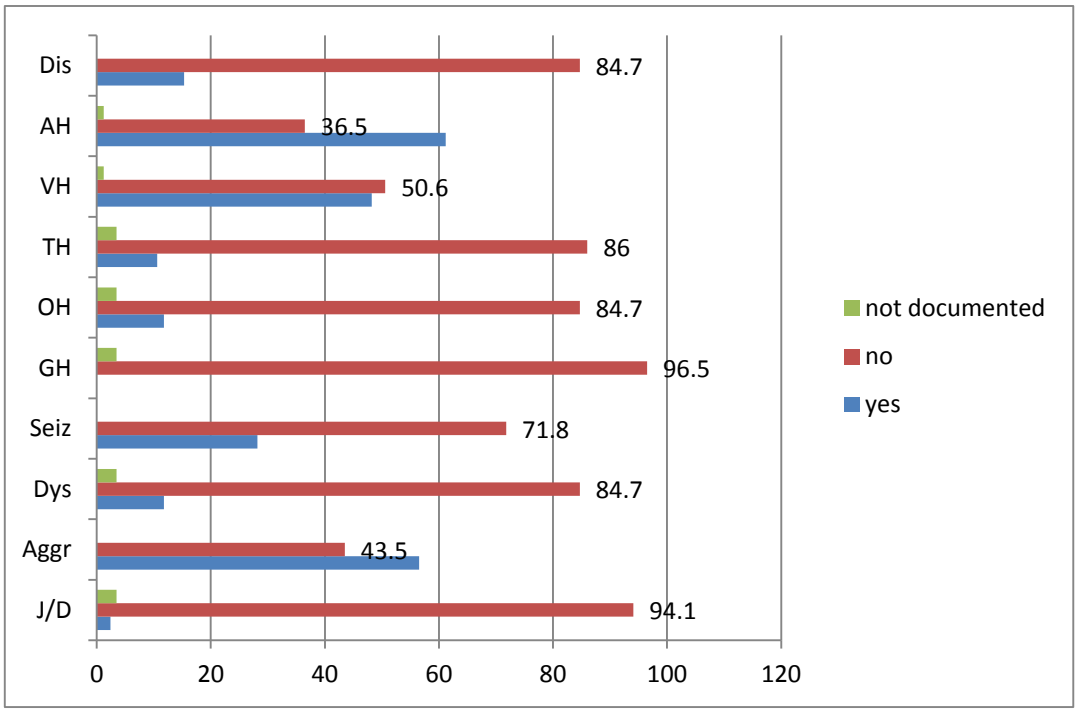
4.3 SYMPTOMS REPORTED PRIOR TO EEG REFERRAL

Auditory hallucinations, aggression and visual hallucinations were the most common documented symptoms in the sample population (Figure 7). None of the users reported gustatory hallucinations. Jamais vu/déjà vu were noted in only a few users. However, it is important to note that not all clinical records had documented whether certain symptoms were present. Symptoms classically considered 'ictal' such as olfactory, gustatory, tactile hallucinations; dysmegalopsia and jamais vu/déjà vu were each not documented in three records.

Figure 7: Symptoms reported prior to EEG referral



Dis: disorientation, AH: auditory hallucination, VH: visual hallucination, TH: tactile hallucination, OH: olfactory hallucination, GH: gustatory hallucination, Seiz: seizure, Dys: dysmegalopsia, Aggr: aggression, J/D: jamais vu/déjà vu

4.4 ADMISSION DIAGNOSIS

Primary mood disorders (bipolar disorder, major depressive disorder) and psychotic disorders (schizophrenia, schizoaffective disorder) were present in over 50% of the population. Of note was the large percentage (27%) of users with underlying medical pathologies manifesting with psychiatric symptoms. This latter group included those with HIV, previous head injuries and possible temporal lobe epilepsy.

Table 2: Admission diagnosis

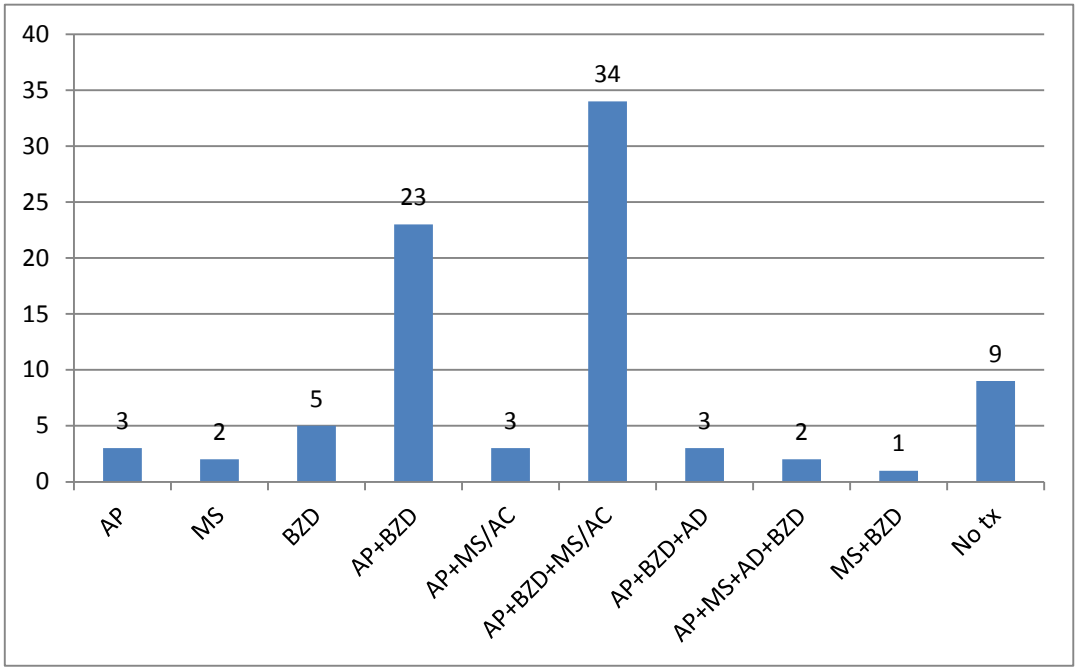
ADMISSION DIAGNOSIS	FREQUENCY	PERCENT
Mood disorder	21	24.7
Psychotic disorder	23	27
Medical/organic pathology	23	27
Substance related disorder	12	14.1
Other	1	1.2

*There were five users without an admission diagnosis.

4.5 MEDICATIONS PRIOR TO EEG REFERRAL

The most common medication regimen users were on prior to EEG referral was a combination of an antipsychotic, benzodiazepine and a mood stabiliser. Medications were continued during EEG recording. Some users were not on any medication (Figure 8).

Figure 8: Medications the sample population were on prior to EEG referral



AP: antipsychotic BZD: benzodiazepine MS: mood stabiliser AD: antidepressant

AC: anticonvulsant

Four users in the AP+BZD+MS/AC group were on anticonvulsants to manage reported seizures, whereas one was on this combination to control both seizures and his mood. One user in the AP+MS/AC was on the anticonvulsant to manage reported seizures.

4.6 EEG RESULTS

EEG recording was normal in the majority (87%) of the sample population. Abnormalities were noted in 8,2% of the sample population. The abnormalities reported were slowing and dysrhythmia. A repeat recording was recommended in two recordings (2,4%) due to artefacts (table 3).

Table 3: EEG results of the sample population

Results	n (%)
Normal, does not exclude epilepsy	74 (87)
'abnormality'	7 (8.2)
Inconclusive (artefacts)	2 (2.4)
No results available	2 (2.4)

4.7 EEG RESULTS MATCHED WITH VARIABLES

The four users with inconclusive results and unavailable results were excluded from statistical analysis.

4.7.1 EEG RESULTS MATCHED WITH DEMOGRAPHICS

None of the demographic variables showed a statistically significant correlation with abnormal EEG results.

Table 4: EEG results matched with demographics

Demographics	n Normal EEG	%	n Abnormal EEG	%	p-value
Age: 18-30 **31-49** **>50**	37 25 12	45.7 30.9 14.8	3 4 0	3.7 4.9	0.5
Gender: **Male** **female**	47 27	58 33.3	3 4	3.7 4.9	0.4
Marital status: **married** **single**	14 60	17.3 74	0 7	8.6	0.34
HLOE: **<G12** **>G12**	53 20	66.2 25	7 0	8.8	0.2
Employment: **unemployed** **employed**	60 14	74.1 17.3	4 3	4.9 3.7	0.15

4.7.2 EEG RESULTS MATCHED WITH SYMPTOMS

None of the symptoms reported prior to EEG referral was associated with an abnormal EEG result. Gustatory hallucinations were not included in the analysis as no user reported experiencing them. However, in three clinical records this information was missing.

Table 5: EEG results matched with symptoms

Symptom	n Normal EEG	%	n Abnormal EEG	%	p-value
Disorientation	12	14.8	1	1.2	1
AH	45	56.2	4	5	1
VH	35	43.7	4	5	0.7
TH	8	10.3	1	1.3	1
OH	8	10.3	1	1.3	1
Seizure	22	27.2	2	2.5	1
Dysmegalopsia	8	10.3	2	2.56	0.17
Aggression	44	54.3	2	2.5	0.2
Jamais vu/déjà vu	2	2.6	0		1

AH: auditory hallucinations, VH: visual hallucinations, TH: tactile hallucinations, OH: olfactory hallucinations

4.7.3 EEG RESULTS MATCHED WITH ADMISSION DIAGNOSIS

There was no positive correlation between the admission diagnosis and abnormal EEG results (p=0.6).

Table 6: EEG results matched with admission diagnosis

Admission diagnosis	**n normal EEG**	**%**	**n Abnormal EEG**	**%**
Mood disorder	19	25	2	2.6
Psychotic disorder	18	23.7	3	3.9
Medical/organic pathology	21	27.6	1	1.3
Substance related disorder	11	14.5	0	0
other	1	1.3	0	0

4.7.4 EEG RESULTS MATCHED WITH MEDICATIONS

Although in one of the abnormal recordings it was mentioned that the abnormality could be due to medication or encephalopathy, there was no statistically significant correlation between antipsychotics (p=0.6), antidepressants (p=1), benzodiazepines (p=0.6) and mood stabilisers (p=0.7) and abnormal EEG results.

4.8 CHANGES IN MANAGEMENT POST EEG

4.8.1 ABNORMAL EEG RESULTS

Of the seven users with abnormal EEG results, four had changes in pharmacological treatment. These changes were based on clinical response rather than EEG results. However, one had a change in diagnosis based on the EEG results (from schizophrenia to Psychosis due to TLE).

4.8.2 NORMAL EEG RESULTS

Twenty nine users (39,1%) with normal results had changes made to their treatment.

Table 7: Summary of users with abnormal EEG results

	(users)	**u1**	**u2**	**u3**	**u4**	**u5**	**u6**	**u7**
DEMOGRAPHICS	Age	34	45	22	24	18	32	39
	Gender	F	F	M	F	M	M	F
	Marital status	S	S	S	S	S	S	S
	HLOE	<G12	<G12	<G12	<G12	<G12	<G12	<G12
	Employment	U/E	U/E	E	E	U/E	U/E	E
	Handedness	R	R	R	R	R	R	R
REASON FOR REFERRAL	*seizure exclusion # other	*	#	*	*	*	*	*
SYMPTOMS PRIOR REFERRAL TO EEG	Disorientation	_	_	+	_	_	_	_
	AH	_	+	+	+	_	_	+
	VH	+	_	+	_	+	_	+
	TH	+	_	_	_	_	_	_
	OH	_	_	_	_	_	_	+
	GH	_	_	_	_	_	_	_
	Seizure	_	_	+	_	_	+	_
	Dysmegalopsia	+	_	_	_	_	_	+
	Aggression	+	_	+	_	_	_	_
	Jamais vu/déjà vu	_	_	_	_	_	_	_
MEDICATION PRIOR REFERRAL TO EEG	Antipsychotic	+	+	+	+	_	_	+
	Antidepressant	_	_	_	_	_	_	_
	ms/ac	ms	_	ac	ms	_	_	_
	benzodiazepine	+	+	+	+	_	_	+

u: user +:yes _ :no M:male F:female Md:married S:single Emp:employed U/E:unemployed G:grade R:right ms: mood stabiliser ac: anticonvulsant

CHAPTER 5: DISCUSSION

5.1 SOCIODEMOGRAPHIC PROFILE

The demographic profile of the sample population was representative of the usual profile of users seen at SFH. Users at SFH are mostly young, unemployed, single males. SFH on average admits one thousand patients per year (hospital statistics for 2008, 2009 and 2010). A total of 85 EEG recordings amongst adults over a year and a half appears small when one considers the number of admissions. This may be an indication that the psychiatrists at SFH refer a patient to EEG when they believe it is necessary rather than routine.

Users aged more than 40 tend to be referred for several investigations to exclude organic pathology. In this study, only one user aged above 40 showed an abnormality on EEG recording.

5.2 REASON FOR REFERRAL TO EEG

The fact that only 85 adult MHCUs were referred for an EEG suggests that clinicians may be referring patients based on clinical grounds rather than as part of a “routine” organic workup. This is in keeping with the suggestions of Lam, [5] and contrary to the opinion of Stone.[19] It may be that psychiatrists in this particular South African setting are not prone to practising defensive medicine which in turn maybe due to a minimal number of litigations experienced.

5.3 SYMPTOMS PRIOR TO EEG REFERRAL

Auditory hallucinations and aggression were the most common symptoms reported (Figure 2). This was not an unexpected finding. Patients referred from other institutions for involuntary treatment are usually uncontained, aggressive and refusing to take medications. Some patients may respond to the auditory hallucinations and act on them and are thus a danger to themselves and others. Symptoms classically referred to as 'ictal'; e.g. tactile and olfactory hallucinations, dysmegalopsia; failed to show an association with an abnormal recording, which, while deemed surprising, may be due the fact that psychiatric patients are notoriously unreliable historians, and may either over report (if they are suggestible) or underreport symptoms.

None of the symptoms showed a statistically significant association with abnormal EEG results, suggesting that neuropsychiatric symptoms may be limited in terms of predicting abnormal EEG's/epilepsy particularly if routine, scalp EEGs are done. This is contrary to the findings in Szabo's study where aggression and hallucinations increased the likelihood of a diagnostic EEG.[12] Adolescents comprised the sample in Szabo's study, whereas the current study focused on adults. The sample size was much smaller in comparison to the current study, and the data was not subjected to statistical analysis. Adolescents may present to psychiatric services differently in comparison to adults, adolescents tend to have much higher incidence than adults of psychotic features when manic.[4] It is possible that these symptoms were overrepresented in the sample.

Two patients with abnormal results had a history of seizures, one had reported generalised tonic clonic seizures in the past and the other one was suspected to have TLE based on

clinical grounds (episodes of bizarre behaviour of a short duration with amnesia of the episode).

5.4 ADMISSION DIAGNOSIS

Mood and psychotic disorders are the most common diagnoses amongst SFH users. In the previous decades these were diagnosed in the context of primary psychiatric illnesses e.g. bipolar I disorder, schizophrenia. The HIV epidemic has had a major impact in psychiatry. Some patients present with mood and psychotic disorders which are secondary to HIV. Various investigations including EEG have to be done to exclude underlying organic pathology masquerading as mood or psychotic disorder.

There was no association between the diagnosis and abnormal EEG results.

5.5 MEDICATIONS PRIOR TO EEG REFERRAL

As highlighted above, a diagnosis of a mood disorder is quite common amongst users at SFH. Most have associated psychotic symptoms and tend to be agitated and aggressive. A combination of a mood stabiliser, mostly sodium valproate, an antipsychotic and a benzodiazepine was seen on the majority of prescriptions. Sodium valproate is preferred over other mood stabilisers because loading dosages can be administered, and it has good antimanic and anti-aggression properties

There was no association between the various medications and abnormal EEG results. Psychotropics have been associated with changes on EEG recording.[8]

Any drug that has a sedative effect on the CNS may produce slowing on EEG.[21] This could account for the slowing on EEG noted in one of the users in this study who was on sodium valproate. Sodium valproate has a sedative effect.

Oller-Daurella L, as cited by Montagu JD et al, reported that carbamazepine use can result in abnormalities on EEG that correlate with clinical improvement.[21] One of the users who was on carbamazepine for suspicion of TLE during EEG recording had nonspecific abnormal slowing on his record. He did not have a baseline EEG prior to commencing carbamazepine. This could have assisted in interpreting the EEG results after medication was started.

5.6 EEG RESULTS

Of the seven patients with abnormal recordings, six were referred for seizure exclusion. The EEG recording could not exclude a seizure disorder conclusively. Thus the clinician had to rely on the patient's history, clinical examination, mental state examination and response to medication to make a final diagnosis, and provide definitive care.

The abnormal results without a clear epileptiform activity in my study could be classified as 'anomalous' as defined by Fenton et al. 'Anomalous' referred to records with an excess of slower background features or minor paroxysmal phenomena of non-specific significance while abnormal ratings were given to those with an unequivocal evidence of organic brain dysfunction or epileptiform activity.[16]

In the study conducted by Stone et al only one patient was found to have an unequivocal evidence of an epileptic focus. Diffuse slowing, diffuse excess of fast activity and temporal dysfunction; were classified as non-diagnostic.[19] It is possible in the current study that a

repeat EEG or enhancing techniques such as sleep deprivation, prolonged recordings (Holter EEGs) could have shown unequivocal evidence of an epileptic focus.

5.7 CHANGES IN MANAGEMENT

5.7.1 Abnormal EEG results

Only one (1,2%) patient's diagnosis changed as a result of an abnormal EEG recording. He was already on carbamazepine (antiepileptic drug) prior to EEG as he was suspected to have temporal lobe epilepsy (TLE). His diagnosis was changed from schizophrenia to psychosis due to TLE.

This is similar to the findings of the study conducted by Warner et al whereby a change in diagnosis only occurred in two cases (1.7%).[15] In the current study, the patient was already suspected to have TLE by his clinician and was already on an epileptic drug. This highlights that clinicians in some cases are able to predict outcome of an EEG as noted in the study by Bowie et al whereby the referring psychiatrist could predict whether or not the recording would be abnormal ($p<0,05$).[17] It also highlights that clinicians do "treat symptoms rather than reports" and may use EEG only to confirm what is suspected.

Another user with abnormal results had reported a history of seizures prior to the EEG being recorded. He had a generalised tonic-clonic seizure in the ward a few days post EEG. He was commenced on sodium valproate CR (antiepileptic drug) based on the witnessed seizure (EEG results were not available at the time).

5.7.2 Normal EEG results

Twenty nine users (39,1%) with normal results had changes made to their treatment based on clinical response rather than EEG results. These changes were in keeping with their psychiatric profiles rather than a suspected epileptic focus.

The low positive yield of scalp EEG and the influence on management was notable. This has been highlighted in previous studies as well. In the study done by Lam et al the routine use of EEG for psychiatric (as well as other patients) without any presenting organic factors was discouraged because of the low yield and negligible clinical significance of normal and abnormal results.[5] Of note in the current study is that more than 60% of the sample already had a suspected or confirmed primary psychiatric disorder or a substance related disorder without any clear, convincing organic factors on mental status and neurological examinations.

5.8 LIMITATIONS

The current study is limited by the retrospective design and the small sample size. The retrospective design of the study has implications for reliability. As the hospital is a teaching facility, different levels of medical personnel rotate through the hospital every six months. Therefore, both junior medical officers as well as senior registrars may have been involved in patient care, and record keeping may be different across levels. In addition, patient reliability and the manner in which neuropsychiatric symptoms are elicited may be limiting factors as well as these would have guided referrals.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

EEG recording, although inexpensive and non-invasive in comparison to other neuroimaging studies, clearly has its limitations. The current study demonstrates that scalp EEG recording had no impact on the clinicians' decisions regarding patient management, except in only one case.

It is recommended that clinicians look carefully at the user's history, mental status examination and neurological examination prior to referral for an EEG. Focusing on only one 'ictal' symptom is discouraged. However, one needs to consider that in an acute psychiatric setting where patients are quite unstable, reliability remains questionable. The clinician is sometimes left with the dilemma of whether or not to act on just one symptom. Delirium, if missed, can be fatal. Thus the risk/benefit ratio must come into play. To reach a definitive diagnosis in psychiatry usually takes more than one session with the patient. Symptoms are managed as they present rather than 'waiting' to have all symptoms to fit particular criteria.

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APPENDIX 1: ETHICS CLEARANCE

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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Meriam Molokomme

CLEARANCE CERTIFICATE	**M090843**
PROJECT	Electroencephalography Referrals and Outcomes in a Tertiary Psychiatric Hospital
INVESTIGATORS	Dr Meriam Molokomme.
DEPARTMENT	Department of Pyschiatry
DATE CONSIDERED	09.08.28
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 30.08.09 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr U Subramaney

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

.....

APPENDIX 2: POSTGRADUATE COMMITTEE APPROVAL

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2745

Reference: Ms Tania Van Leeve
E-mail: tania.vanleeve@wits.ac.za
27 October 2009
Person No: 309711
PAG

Dr MM Molokomme
P O Box 1750
Sovenga
0727
South Africa

Dear Dr Molokomme

Master of Medicine in the specialty of Psychiatry: Approval of Title

We have pleasure in advising that your proposal entitled "*Electroencephalography referrals and outcomes in a tertiary psychiatric hospital*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

APPENDIX 3: CONSENT FROM HOSPITAL CEO

Department of Health
Lefapha la Maphelo
Departement van Gesondheid
Umnyango wezempilo
OFFICE OF THE CEO
STERKFONTEIN HOSPITAL

ENQUIRES: **Dr K.A. Mustafa**

DR M.M. MOLOKOMME
Psychiatry Registrar

MMED PSYCHIATRY RESEARCH PROJECT

Please be informed that management has given you permission to conduct your research study at Sterkfontein Hospital.

Thank you.

K.A. Mustafa

DR K.A. MUSTAFA
CHIEF EXECUTIVE OFFICER

10/07/2009

PRIVATE BAG X2010, KRUGERSDORP 1740
TEL (011) 951-8257 FAX (011) 956-6907 EMAIL : Sithole.Toleka@gauteng.gov.za

APPENDIX 4: INFORMATION SHEET

TITLE OF STUDY: EEG REFERRALS AND OUTCOMES IN A TERTIARY PSYCHIATRIC HOSPITAL

SUPERVISOR: DR U SUBRAMANEY (PRINCIPAL PSYCHIATRIST, STERKFONTEIN HOSPITAL)

STUDENT: DR M M MOLOKOMME (REGISTRAR)

Hello,

My name is DR MERIAM MOLOKOMME. I am training to become a psychiatrist, and am registered with Witwatersrand University. As part of my training, I am conducting a study of the EEG records done in Sterkfontein hospital from January 2008 to June 2009. The aim of the study is to determine whether EEG results impact on the patient's diagnosis and treatment.

To conduct the study I will need consent from the patients who had this test during the study period and are still admitted to Sterkfontein hospital. You/your relative have been/has been identified as one of those patients who had an EEG test during the abovementioned period and I would like your consent to look at your/your relative's records. Giving consent is not going to impact in any way on your/your relative's treatment in hospital. The consent only allows me access to your/your relative's clinical and EEG records. I am the only one who will have access to the files for this purpose, thus confidentiality will be respected at all times. Your/your relative's name WILL NOT be used in the study; instead numbers will be allocated to each file.

Your help will be appreciated.

Regards

DR M M MOLOKOMME

MP 0592188

011 933 9239

APPENDIX 5: INFORMED CONSENT

CONSENT FORM

I _____ confirm that I have read and understood the information sheet and agree to give consent for the study.

DATE:

X_____

PATIENT

I (CEO OF SFH/NEXT-OF-KIN) _____ confirm that I have read and understood the information sheet and agree to give consent for the study on behalf of

_____

DATE:

X_____

CEO/NEX OF KIN

APPENDIX 6: DATA COLLECTION SHEET

Demographics	
Patient number	
Age	
Gender 1=male 2=female	
Marital status 1=single 2=married	
Highest level of education 1=<grade 12 2= >/=grade 12	
Employment status 1=employed 2=unemployed	
Handedness 1=right 2=left	

Reason for referral to EEG	
1= exclude seizure disorder 2= other('workup', treatment non-response)	

Symptoms prior EEG request	
Disorientation 1=yes 2=no	
Auditory hallucination 1=yes 2=no	
Visual hallucination 1=yes 2=no	
Tactile hallucination 1=yes 2=no	
Olfactory hallucination 1=yes 2=no	
Gustatory hallucination 1=yes 2=no	
Seizure 1=yes 2=no	
Dysmegalopsia 1=yes 2=no	
Aggression 1=yes 2=no	
Jamais vu/déjà vu 1=yes 2=no	

Admission diagnosis	
Diagnosis on discharge	

Medications	
Number of medications prior EEG 1: </=2 2:>2	
Antipsychotic 1:yes 2:no	
Antidepressant 1:yes 2:no	
Benzodiazepine 1:yes 2:no	
Mood stabiliser 1:yes 2:no	
Treatment change after EEG 1:yes 2:no	
Treatment change based on: 1: EEG results 2: other	

EEG	
Provocation method prior EEG 1:yes 2:no Specify:	
Provocation method during EEG 1:yes 2:no Specify:	
EEG abnormality 1:yes 2:no 3:non-conclusive	

EEG abnormality detected: