



Length of Stay in the Epilepsy Unit Utilizes Standardized Clinical Pathway

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ABSTRACT

Background: Drug-resistant epilepsy defined as persistent seizures despite adequate doses of two appropriate first-line antiepileptic drugs (AED). Uncontrolled seizures cause injuries, disability, and increased mortality, thus surgery should be considered once the seizures are proven to be medically resistant. Surgical interventions may benefit patients (pts) with incomplete responses to AEDs after evaluation in the epilepsy monitoring unit (EMU) under video-EEG monitoring.

Video-EEG monitoring in the epilepsy monitoring unit (EMU) is a limited clinical resource and availability of standardized units even scarcer. Knowledge of the preadmission predicting factors for length of stay (LOS) in the EMU may allow providers to utilize hospital resources and EMU beds more efficiently.

Purpose: This study investigates the effect of patient-related variables, in-EMU -hospital stay for maximum EMU resource utilization.

Methods: The records for all consecutive admissions to the EMU stay at King Faisal Specialist Hospital & Research Centre, between January 1, 2016 and December 31, 2016 will be reviewed retrospectively.

Results: Our results about univariate analyses focusing on variables known before admission shows that EMU LOS (in days) was not significantly correlated with patient age, number of event types, or number of AEDs at admission. While the number of seizures recorded in EMU significantly correlated with age.

Conclusion: Pre-admission clinical variables may predict EMU LOS. These factors could be used at the administrative level for maximum EMU resource utilization. The Clinical Pathway (CP) we established below is a general guideline and does not replace clinical judgment. Care should be individualized to meet the specific needs of each patient. The CP can, therefore, be deviated from when deemed appropriate with the reason documented.

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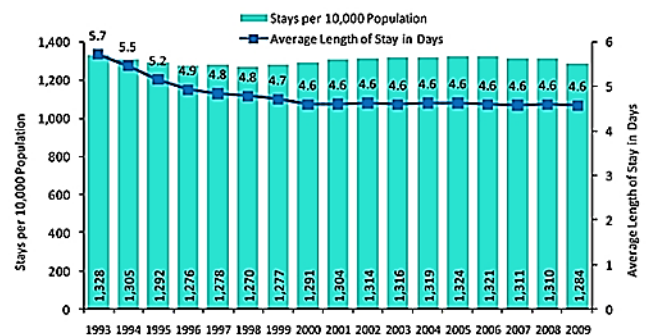
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1. Introduction:

Research is essential to appropriately determine the appropriate length of hospital stay (LOS) in hospitals (Borghans et al., 2008). Substantially, length of hospital stay (LOS) is influenced by many factors, for instance, the age and the diagnosis of the patient. A recent study has proposed that the length of hospital stay (LOS) is prolonged in malnourished geriatric patients compared to those who are not (Gärtner et al., 2017).

Statistically, the average length of hospital stays, as well as the number of outpatients and the stability in in-patient and daycare patient discharges demonstrates three main dynamics. First of all, demographic changes that



Hospital Stays per 10,000 Population and Average Length of Stay, 1993–2009
Source: AHRO, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1993–2009.



show the impact of different groups on the demand for hospital services. Secondly, the study lists the financial burdens and the affordability of costs for the provided services. Lastly, it reveals the impact of practical and technological alterations on acute care length, and on the balance between in-patient services, day services and outpatient services (Hospital discharges and length of stay statistics, 2017)

In the U.S., the average length of stay was reported to be roughly 4.6 days in 2009. Although, it was stated that the average length of stay diminished by approximately 20-percent in the 1990s (5.7 days), the average length of stay has not changed significantly since 2000 (Rockville, 2011).

In comparison, statistical analysis of EU Member States exhibited a range of 5.3 to 9.5 days of in-patient stay length, in 2015. Similarly, the average length of hospital stays diminished in the last five years. Additionally, the study displayed certain factors that influenced the average length of stay such as, age, gender, and diagnosis. Female admissions were more than those of the males; however, the average length of stay for females was generally shorter in duration among the large majority of the EU Member States.

The analysis of the average length of stays in different age groups revealed a shorter length of in-patient stays for young children aged 1-4, 5-9, and 10-14 compared to infants aged less than one year. Then, the average escalated through the age group (50-54) until it plateaued at the age group of 65-69. Thereafter, the average length of stay increased up until it peaked in the higher age groups, precisely 85-89, 90-94, or 95 and over. Finally, the paper analyzed the average length of stay of nine diagnoses, amongst the diagnoses; the average was larger in mental and behavioral disorders in the vast majority of EU Member States (Hospital discharges and length of stay statistics, 2017).

In Saudi Arabia, there are no statistical analyses of the average length of hospital stays in the literature. However, a study was published demonstrating the variances in the average length of hospital stay of patients (pts) in rehabilitation programs. This particular study detected a higher prevalence of certain pediatric neurologic disorders, for example, mental retardation 26.3 in every 10000 people, and cerebral palsy 23.4 in every 10000 people in Saudi Arabia.

In the study, 3837 records of patients, who were around 32.9 ± 16.4 years of age, were explored. Predominantly, the study population exhibited an average of 46.7 ± 25.7 days of hospital stay. Furthermore, the reports displayed longer average length of hospital stay amongst patients of traumatic spinal cord injuries (58.4 ± 29.1) and traumatic brain injury (57.4 ± 27.7). In contrast, pediatric neuro-rehabilitation reports demonstrated a shorter average length of hospital stay, which was 32.2 ± 18.7 days. Therefore, more research is needed to explore the statistical aspects of patients' records in healthcare

facilities, particularly, the average length of stay in Saudi hospitals, to determine the appropriate length of stay for different diagnoses (Al-Jadid & Robert, 2012).

2. Length of Stay for Neurological Patients in Hospital:

2.1. Stroke

Stroke is one of the leading causes of neurological damage and death in geriatric patients. In Korea, the large majority of geriatric patients are being medically treated for cerebrovascular disorders (Kim et al., 2013). In a Taiwanese study, 1084 stroke cases were studied, and on average, the length of hospital stay was found to be 13.9 ± 14.1 days, ranging from 1 day to 129 days. The study has also proposed that the length of hospital stay is a major predictive factor of the health services costs (Huang et al., 2013). In a Canadian study, the length of stay for stroke patients in rehabilitation was 35 days (Grant et al., 2014). A Korean paper, which investigated 17,364 reported stroke cases, showed a stay length average of 18.6 days. Besides, the length of stay was 16.7 days longer in patients who received surgical management (Kim et al., 2013).

2.2. Guillain-Barré syndrome

Guillain-Barré syndrome (GBS) is a life-threatening acute immune-mediated polyradiculoneuropathy. Clinically, patients present with an acute onset of progressive flaccid paralysis. On average, it affects 1.1 to 1.8 per 100,000 people in Europe and North America (Harms, 2011). Principally, the length of stay depended on the severity and the disability of the patient. However, it was reported that the mean length of hospital stay in Guillain-Barré syndrome patients is 17 days, ranging from 11 days to 26 days (Van Leeuwen et al., 2016). Markedly, the mean length of hospital stay in Guillain-Barré syndrome patients was correlated with the time with which intravenous immune-globin is received. * A study analyzed the medical records of 69 patients which concluded that the mean length of hospital stay of patients who received no treatment was 47.4 days, while patients who were treated with intravenous immune-globin on the sixth day was 32.4, and the patients who received the intravenous immune-globin in the first five days was 21.3 days (Coll-Canti et al., 2009).

2.3. Multiple sclerosis

Multiple sclerosis is one of the most common inflammatory neurodegenerative disorders. MS is a leading cause of non-traumatic disability in young adults of several countries affecting more than two million people worldwide (Heydarpour et al., 2015). In 2012, a study evaluated 6601 MS records showed a diminished number of hospital admissions in the previous 20 years. However, it demonstrated an increase in the length of hospital stay, which was stated to be 13 days for MS-related conditions (Evans, et al., 2012). According to Pediatric Health Information System (PHIS) database, pediatric multiple



sclerosis patients in the US were hospitalized twice with a mean hospital stay length of 4 days between 2004 and 2013 (Lavery et al., 2016).

2.3. Migraine

In the United States, migraine affects approximately 13 percent of the adult population. Typically, the clinical presentation of migraine includes severe episodic throbbing headaches that persist for four to 72 hours. Additionally, migraine is often associated with nausea, vomiting, and photophobia (Najjar et al., 2017). In 2008, migraine was the leading cause for inpatient admissions in the United States with an average length of stay of 2.7 days, which is shorter than the average length of all admissions (4.6 days) (Goldberg, 2015).

3. Length of Stay Epilepsy Patients in Hospital:

In the United States, epilepsy is one of the most prevalent neurological disorders in childhood, affecting 10.2 children in every 1000 (Widjaja et al., 2013). In 2008, the admission rate of epilepsy patients has increased to 170,484 admissions, in comparison to 68,676 admissions in 1993 (Widjaja et al., 2013). Epilepsy is associated with high rates of morbidity and low rates of mortality. Consequently, the hospitalization of epilepsy patients costs extreme expenses (Widjaja et al., 2013). Evaluation of inpatient admissions and length of stay is essential to improve the management of epilepsy in the affected population. The data displayed a mean length of stay of 5.4 days for all epilepsy patients and 5.5 days for epilepsy patients who are affected by epilepsy complications. Last but not least, the average length of stay in patients who received surgical treatment was nearly 12 days (Widjaja, et al. 2013).

3. Length of Stay Epilepsy Monitoring Unit (EMU) Patients in Hospital:

In the United States, epilepsy affects 2.5 million Americans with an additional 181,000 newly diagnosed patients annually (Smolowitz et al., 2007). Thereby, an appropriate diagnosis is necessary for the management of patients with persistent seizures. Patients frequently present with different symptoms that can mimic epilepsy, which increases the risk of misdiagnosing the patients (Smolowitz et al., 2007). Hence, patients with persistent seizures that do not respond to antiepileptic drugs in 1 year are recommended to be referred to specialized epilepsy centers for re-evaluation and inpatient video-electroencephalographic monitoring in epilepsy monitoring unit (Smolowitz et al., 2007).

Primarily, epilepsy-monitoring units help evaluate, accurately diagnosing, and planning the appropriate treatment for patients with epilepsy. Even though the paroxysmal pattern of epilepsy is complicating the regulation and the standardization of the length of stay in the epilepsy monitoring unit, yet research is shedding the

light on the possibility of regulating the LOS in epilepsy monitoring units. A study of the New York University Langone Medical Center Adult Epilepsy Monitoring Unit reported that the average length of stay for video-electroencephalographic monitoring in 905 patients was 8 days, SD 4.1 days (Gazzola et al., 2016). Furthermore, the length of the epilepsy monitoring unit stay was 4.3 days for the patients who were treated with less than three AEDs. In contrast, the average stay was longer in the patients who received more than two AEDs (6.3 days). Nonetheless, the growing demand for epilepsy monitoring units has exceeded the capacity of epilepsy monitoring units' beds. Therefore, standardization of the length of stay in epilepsy monitoring units would limit the gratuitously prolonged stays in epilepsy monitoring units (Moseley et al., 2016).

In summary, epilepsy-monitoring units (EMU) are crucial in diagnosing epileptic seizures and psychogenic non-epileptic seizures. However, the length of stay in EMUs is unregulated leading to the excessive length of stay. Accordingly, the length of stay in epilepsy monitoring units should be evaluated and standardized to improve the efficacy of epilepsy monitoring services and to facilitate regulation of the costs and the quality of the management system in epilepsy patients.

4. Methods:

In this observational analytical cohort study, we retrospectively collected data from the medical records of all consecutive admissions to the EMU stay at King Faisal Specialist Hospital & Research Centre between January 1, 2016 and December 31, 2016. The sample collected included 159 patients, the inclusion criteria were all patients who were admitted to the EMU at King Faisal Specialist Hospital & Research Centre between January 1, 2016 and December 31, 2016. Additionally, there was not an exclusion criterion.

The patients were scheduled to be admitted to EMU for diagnostic video and EEG monitoring. The collected data from 159 patients, included the patient's age, length of stay, the number of days the patient was connected to the monitor, diagnosis, frequency of seizures, the stereo typicality of the seizures, and the presence of surgical treatment in the management plan. Thereafter, the data were statistically analyzed and different variables were compared, to evaluate the impact of different variables on the length of stay in EMU. Last but not least, the research protocol was approved by the Institutional Review Board (IRB).

4. Results:

In the study period, the records included 159 admitted patients. A total of 159 was statistically evaluated, however, 1 medical record of a patient did not contain information about the age and the days of connecting to EEG.



4.1. Age

The age of patients varied, 21.5% of the patients (34 patients) are of the age group 0-10, 34.2% (54 patients) are of the age group 11-20, 21.5% (34 patients) are of the age group 21-30, 20.9% (33 patients) are of the age group 31-50, and 1.9% (3 patients) are older than 50.

4.2. Diagnoses

The diagnosis varied amongst the patient. Generally, most patients (121 patients, 76.1%) had a diagnosis of an epileptic seizure. On the contrary, 23 patients had non-epileptic seizures, accounting for 14.47% of the study population. Lastly, there are 15 patients (9.43%) who were not successfully diagnosed for different reasons.

4.3. length of stay (LOS)

The largest group of patients (29.56%, 47 patients) stayed for 10-15 days. Additionally, 10 patients (6.29%) stayed for 1-3 days, 27 patients (16.98%) stayed for 4-6 days, 41 patients (25.79%) stayed for 7-9 days, 22 patients (13.84%) stayed for 16-20 days, 12 patients (7.55%) stayed for >20 days.

4.4. Connection Days

In the Epilepsy Monitoring Unit (EMU), 4 patients (2.53%) were not connected to the EEG during their stay. However, 27 patients (17.09%) were connected for 1-3 days, 58 patients (36.71%) were connected for 4-6 days, 41 patients (25.95%) were connected for 7-9 days, 24 patients (15.19%) were connected for 10-15 days, 3 patients (1.90%) were connected for 16-20 days, and 1 patient (0.63%) was connected for >20 days (see table 1).

4.5. Frequency

During the EMU stay, there are 18 patients (11.32%) did not have seizures, 16 patients (10.06%) had 1-3 seizures, 37 patients (23.27%) had 4-6 seizures, 24 patients (15.09%) had 7-9 seizures, 57 patients (35.85%) had 10-15 seizures, 3 patients (1.89%) had 16-20 seizures, and 4 patients (2.52%) had >20 seizures.

4.6. length of stay (LOS)-Connection days

1.90% (3pts) who was not connected stayed for 1-3 days. 5.06% of patients (8pts) stayed 4-6 days were connected for 1-3 days. (may suggest that 1-3 days are not enough). 27 pts 17.0% of patients, stayed for 7-9 days were connected for 4-6 days. 23 pts 14.56% of patients were connected for 7-9 days, stayed for 10-15 days. 14pts 8.86% of patients were connected for 10-15 days, stayed for 10-15 days. 2 pts 1.27% of patients connected for 16-20, stayed for more than 20 days. 1 pts 0.63% of patients connected for >20, stayed for more than 20 days. 29.75% (47) of the patients stayed for 10-15. 36.71% (58 patients) of the patients were connected for 4-6 days.

Table 1: LOS_days by connection_time_days

LOS_days	Connection_Time_Days						
	0	1-3 d	4-6 d	7-9 d	10-15 d	16-20d	> 20d
Frequency							
Percent							
1-3d	3 1.90	7 4.43	0	0	0	0	0
4-6d	1 0.63	8 5.06	17 10.76	0	0	0	0
7-9d	0	7 4.43	27 17.09	7 4.43	0	0	0
10-15d	0	2 1.27	8 5.06	23 14.56	14 8.86	0	0
16-20d	0	1 0.63	3 1.90	9 5.70	8 5.06	1 0.63	0
> 20d	0	2 1.27	3 1.90	3 1.90	1 0.63	2 1.27	1 0.63

70% of patients were connected for 1-3 days. 30% weren't connected at all. Patients admitted for 4-6 days, 65.38% were connected for 4-6 days. 30.77% were connected for 1-3 days, and 3.85% were not connected. Patients admitted for 7-9 days, 14.63% were connected for 7-9 days. 65.85% were connected for 4-6 days. 17.07% were connected for 1-3 days, and 0% were not connected.

Patients admitted for 10-15 days, 29.79% were connected for 10-15 days. 48.94% were connected for 7-9 days. 17.02% were connected for 4-6 days. 4.26% were connected for 1-3 days, and 0% was not connected.

Patients admitted for 16-20 days, 4.55% (1 patient) of the patients were connected for 16-20 days. 36.36% Of the patients were connected for 10-15 days. 40.91% Of the patients were connected for 7-9 days. 13.64% Of the patients were connected for 4-6 days. 4.55% Of the patients were connected for 1-3 days, and 0% Of the patients were not connected.

Patients admitted for >20 days (LOS), 8.33% (1 patient) Of the patients were connected for >20 days. 16.67% Of the patients were connected for 16-20 days. 8.33% Of the patients were connected for 10-15 days. 25.00% Of the patients were connected for 7-9 days. 25.00% Of the patients were connected for 4-6 days. 16.67% Of the patients were connected for 1-3 days, and 0% Of the patients were not connected.

4.7. LOS – Seizure Frequency

4.40% (7 pts) of patients with 0 seizures stayed 4-6 days in EMU. 4.40% (7pts)of patients with 1-3 seizures stayed 7-9 days in EMU. 15.1% (24pts)of patients with 4-6 seizures stayed 10-20 days in EMU. 11.32% (18pts)of patients with 7-9 seizures stayed 7-15 days in EMU.



Table 2: LOS – seizure Frequency

LOS_days	Frequency_seizures						
	0	1-3d	4-6d	7-9d	10-15d	16-20d	> 20d
1-3d	4 2.52	0	0	1 0.63	5 3.14	0	0
4-6d	7 4.40	1 0.63	3 1.89	4 2.52	12 7.55	0	0
7-9d	1 0.63	7 4.40	9 5.66	9 5.66	11 6.92	1 0.63	3 1.89
10-15d	5 3.14	3 1.89	12 7.55	9 5.66	16 10.06	1 0.63	1 0.63
16-20d	1 0.63	4 2.52	12 7.55	1 0.63	4 2.52	0	0
> 20d	0	1 0.63	1 0.63	0	9 5.66	1 0.63	0

10.06% (16) of patients (pts) with 10-15 seizures stayed 15-10 days in EMU. 3 patients (1.89% of all patients) had 16-20 seizures and stayed for random days. 1.89% (3pts) of patients with >20 seizures stayed 7-9 days in EMU. 29.75 % (47) of the patients stayed for 10-15 accounted for the commonest number of seizures experienced by the patients (57 times, 35.85%).

Patients admitted for 1-3 days, 40.00% had no seizures. 10.00% had 7-9 seizures. 50.00% had 10-15 seizures. 0% had 1-6 seizures. 0% had >16 seizures.

Patients admitted for 4-6 days, 25.93% had no seizures. 70% had 1-3 seizures. 11.11% had 4-6 seizures. 14.81% had 7-9 seizures. 44.44% had 10-15 seizures. 0.00% had 16-20 seizures. 0.00% had >20 seizures.

Patients admitted for 7-9 days, 2.44% had no seizures. 17.07% had 1-3 seizures. 21.95% had 4-6 seizures. 21.95% had 7-9 seizures. 26.83% had 10-15 seizures. 2.44% had 16-20 seizures. 7.32% had >20 seizures.

Patients admitted for 10-15 days, 10.64% had no seizures. 6.38% had 1-3 seizures. 25.53% had 4-6 seizures. 19.15% had 7-9 seizures. 34.04% had 10-15 seizures. 2.13% had 16-20 seizures. 2.13% had >20 seizures.

Patients admitted for 16-20 days, 4.55% had no seizures. 18.18% had 1-3 seizures. 54.55% had 4-6 seizures. 4.55% had 7-9 seizures. 18.18% had 10-15 seizures. 0% had 16-20 seizures. 0% had >20 seizures.

Patients admitted for 7-9 days, 0% had no seizures. 8.33% had 1-3 seizures. 8.33% had 4-6 seizures. 0% had 7-9 seizures. 75.00% had 10-15 seizures. 8.33% had 16-20 seizures. 0% had >20 seizures.

4.8. Connection days – Seizure Frequency

There are 4 patients (pts) (2.53%) who were not connected, no seizures. 16 pts 10.13% of pts connected for 1-3 days had 10-15 seizures. 18 pts 11.39% of pts connected for 4-6 days had 10-15 seizures. 17 pts 10.76% of pts connected for 7-9 days had 4-6 seizures. 10 pts 6.33% of pts connected for 10-15 days had 10-15 seizures. 3 pts were connected for 16-20d, all had <15 seizures. There is 1 pts connected for >20d and they had 10-15 seizures.

Table 3 Connection days – Seizure Frequency

Frequency seizures	connection_time_days						
	0	1-3d	4-6d	7-9d	10-15d	16-20d	> 20d
0	4 2.53	1 0.63	5 3.16	3 1.90	4 2.53	0	0
1-3d	0	0	6 3.80	4 2.53	5 3.16	1 0.63	0
4-6d	0	4 2.53	11 6.96	17 10.76	4 2.53	1 0.63	0
7-9d	0	5 3.16	14 8.86	4 2.53	1 0.63	0	0
10-15d	0	16 10.13	18 11.39	11 6.96	10 6.33	1 0.63	1 0.63
16-20d	0	0	1 0.63	2 1.27	0	0	0
> 20d	0	1 0.63	3 1.90	0	0	0	0

55 pts were connected for 4-6, 53 of them had >1 seizures during their stay. 41 pts were connected for 7-9, 38 of them had >1 & <20 seizures during their stay. 60.76% of the patients (96 patients) were connected for 4-9 days, and they had between 1 and 20 seizures during their stay in the EMU. 74.06% (117 patients) of pts had seizures in less than 10 connection days. 86.72% (137 patients) of pts had seizures in less than 10 connection days. 45 patients (28.48% of the patients) who had 10-15 seizures during their stay, were connected for 1-6 days.

1 pt(5.88%) had 0 seizures- connected for 1-3 days. 5 pts(29.41%) had 0 seizures- connected for 4-6 days. 3 pts(17.65%) had 0 seizures- connected for 7-9 days. 4 pts(23.53%) had 0 seizures- connected for 10-15 days. There are 4 patients, weren't connected and did not have seizures.

6 pts(37.50%) had 1-3 seizures- connected for 4-6 days. 4 pts(25%) had 1-3 seizures- connected for 7-9 days. 5 pts(31.25%) had 1-3 seizures- connected for 10-15 days. 1 pt(6.25%) had 1-3 seizures- connected for 16-20 days.

4 pt(10.81%) had 4-6 seizures- connected for 1-3 days. 11 pts(29.73%) had 4-6seizures- connected for 4-6 days. 17 pts(45.95%) had 4-6 seizures- connected for 7-9 days. 4 pts(10.81%) had 4-6 seizures- connected for 10-15



days. 1 pt(2.7%) had 4-6 seizures- connected for 16-20 days.

5 pt(20.83%) had 7-9 seizures- connected for 1-3 days. 14 pts(58.33%) had 7-9 seizures- connected for 4-6 days. 4 pts(16.67%) had 7-9 seizures- connected for 7-9 days. 1 pts(4.17%) had 7-9 seizures- connected for 10-15 days.

16 pts (28.07 %) had 10-15 seizures- connected for 1-3 days. 18 pts (31.58%) had 10-15 seizures- connected for 4-6 days. 11 pts (19.30%) had 10-15 seizures- connected for 7-9 days. 10 pts (17.54 %) had 10-15 seizures- connected for 10-15 days. 1 pt(1.75%) had 10-15 seizures- connected for 16-20 days.

1 pts (33.33%) had 16-20 seizures- connected for 4-6 days. 2 pts (66.67%) had 16-20 seizures- connected for 7-9 days. No other patient had 16-20 seizures.

1 pt (25 %) had >20 seizures- connected for 1-3 days. 3 pts (75%) had >20 seizures- connected for 4-6 days. No other patient had >20 seizures.

4.9. Stereotypically

94 of the patients had stereotypical epilepsy (59.12%), 46 patients (28.93%) had non-stereotypical epilepsy, and 19 patients (11.95%) did not have seizures.

4.9.1. Frequency_seizure

The mean frequency of seizures experienced by patients with stereotypical epilepsy is 8.4. While the mean for the patients with non-stereotypical epilepsy is 8.8.

4.9.2. Connection_Time_Days

The mean of the number of days of which patients with stereotypical epilepsy were connected to the EEG is 6.6 days. Similarly, patients with non-stereotypical epilepsy had a mean of 6.3 days. Lastly, the patients, who had 0 seizures in EMU, the mean of connection days is 5.5 days.

4.9.3. LOS_days

The mean LOS of patients with stereotypical epilepsy is 11.6 days, 11.5 days for patients with non-stereotypical epilepsy, 7.4 days for those who had 0 seizures.

4.10. Surgical treatment

The majority of the patients (100 patients, 62.89%) underwent surgical treatment as part of managing epilepsy, and the remaining 59 patients (37.11%) did not undergo surgery to treat epilepsy.

4.10.1. Frequency_seizure

The mean number of seizures experienced by patients, who underwent surgery, is 8.4 days; and 6.1 for the patients, who did not undergo surgery.

4.10.2. Connection_Time_Days

The mean number of days of which the patients, who underwent surgery, were connected to EEG is 6.6. and the mean is 6.2 for the patients who did not undergo surgery.

4.10.3. LOS_days

The mean LOS of patients is 11 for those who underwent surgery, and the mean is 8 for those who did not undergo surgery.

5. Discussion

To our knowledge, this study represents the first study to analyze the consecutive series of EMU admissions and evaluate different variables in the Middle East. The data of the study demonstrate that the influence of different variables on LOS can be used to utilize and standardize the LOS for EMU admission.

5.1. Results Interpretation

There were 159 patients admitted in the study period, most of them were between the ages of 1 and 30 (77.2% of the patients). Generally, the majority (121 patients, 76.1%) had a diagnosis of an epileptic seizure.

The majority of the patients stayed between 7 to 15 days in the EMU; 29.56% of the patients (47 patients) stayed for 10-15 days, and the other 41 patients (25.79% of the patients) stayed for 7-9 days.

5.2. Connection_time_days

Generally, 66.62% of the patients were connected for 4-9 days. In the EMU, 4 patients (2.53%) were not connected to the EEG during their stay. However, 27 patients (17.09%) were connected for 1-3 days, 58 patients (36.71%) were connected for 4-6 days, 41 patients (25.95%) were connected for 7-9 days, 24 patients (15.19%) were connected for 10-15 days, 3 patients (1.90%) were connected for 16-20 days, and 1 patient (0.63%) was connected for >20 days.

5.3. Frequency

A big portion of the patients (57 patients, 35.85%) had 10-15 seizures, also there are 37 patients (23.27%) had 4-6 seizures. And data demonstrates that the majority of the patients had 4-15 seizures (118 patients, 74.21%).

5.4. LOS-Connection days

There are 3 patients stayed for 1-3 days and one patient stayed for 4-6 days were not connected, which indicates the lack of organized preparation of the patients scheduled to be admitted.

Only 7 patients stayed 1-3 days and they were connected for 1-3 days, which may suggest that 1-3 days are not enough to diagnose most of the patients. 62.66% of the patients (99 patients) were connected for 4-9 days in the EMU, although, the LOS for 88 patients (55.7% of the



patients) stayed for 7-15 days in the EMU, also another 34 patients (21.51%) stayed more than 15 days in the EMU. The data exhibits regular EMU admissions that are longer than the days the patients are connected to the EEG for diagnosing their cases.

5.5. LOS – Seizure Frequency

21.38% (32 patients) of patients had less than 3 seizures during their stay in EMU. A good number of patients (56 patients, 36.48% of the patients) had 4-15 seizures and they stayed for 7-20 days in the EMU. 4.41% of the patients (7 patients) had more than 15 induced seizures during their stay. 10-15 number of seizures accounted for the number of seizures experienced by the highest number of patients (57 times, 35.85%). 28.07% (16 patients) of patients had 10-15 seizures stayed 15-10 days in EMU. The majority of the patients (118pts, 74.21% of the patients) had between 4 to 15 seizures during their stay in the EMU.

5.6. Connection days – Frequency

A good percentage of people (45 patients, 28.48% of the patients) had 10-15 seizures during their stay, and they were connected for 1 to 6 days. There are 4 patients were connected for more than 15 days, they all had less than 15 seizures during their long stay.

The majority of the patients, 60.76% of the patients (96 patients), were connected for 4 to 9 days, and they had between 1 and 20 seizures during their stay in the EMU. Although, 86.72% (137 patients) of patients had seizures in less than 15 connection days. Remarkably, 74.06% (117 patients) of patients had seizures in less than 10 connection days. The data suggests there isn't a need for more than 15 seizures to diagnose and evaluate the patient. Also, the majority of the patients (100 patients) had between 4 and 15 seizures in less than 9 days, while connected to the EEG in the EMU.

5.7. Stereo typicality

Most of the patients (94 of the patients) were diagnosed with epilepsy (59.12%), which means most data represents patients with epilepsy.

The data does not demonstrate any significant difference in the mean number of seizures the patients had during their stay. The mean connection days were almost the same for patients with stereotypical and non-stereotypical seizure, however, it was almost 1 day less for patients who did not have any seizures.

Likewise, The mean LOS of patients with epilepsy equals the mean LOS for those with non-stereotypical seizure, and the mean LOS decreases by 4.15 days for those who had 0 seizures.

In general, stereo typicality did not show any significant influence on the frequency of the seizures, EEG connection days, nor did it significantly impact the LOS.

5.8. Surgical Treatment

The majority of the patients (100 patients, 62.89%) underwent surgical treatment as part of managing epilepsy, which may indicate that stereotypical epileptic patients tend to require some sort of surgical intervention as part of the management plan. The mean number of seizures experienced by patients who underwent surgery was higher than those who did not undergo surgery.

Even though the mean number of connection days did not demonstrate any major difference between patients who underwent surgeries and those who did not, the mean LOS of both of the groups of patients showed significant differences. Approximately, patients who underwent surgery as part of their management plan stayed 3 days longer than those who did not undergo surgical intervention.

Video-electroencephalographic monitored EMU admission is the gold standard for diagnosing and managing epileptic and non-epileptic seizures (Rizvi et al., 2014). Statistically, EMU admission eliminates the costs and harm of blindly prescribed treatment for patients with unresponsive seizures (Moseley et al., 2016).

Formerly, studies have demonstrated an average of stay in multiple EMUs ranging from 1 day to over a week (Spritzer et al., 2014). For example, a study done in 2006 reported an average length of stay of 3-4 days (Moseley et al., 2015). Additionally, another study has shown a length of stay of more than 7 days (Moseley et al., 2016).

However, EMU holds its risks and economic burden on the health system (Rizvi et al., 2014). Prolonged video-electroencephalographic monitored diagnosis has been associated with seizure clusters (6.9%), status epilepticus (1.6%), test complications (3.7%), sudden unexpected death in epilepsy (SUDEP), psychiatric concerns (4.3%), and medication side effects (1.6%) (Moseley et al., 2016).

On the other hand, short EMU admissions are shown to decrease the efficacy and accuracy in diagnosing admitted patients, leading to a higher rate of ED visits and an elevated number of 30-day hospital readmission of the patients (Moseley et al., 2015).

Few studies have suggested the effect of some factors on the LOS in EMU, for instance, younger patients had shorter (of 1.2—1.5 days) LOS (Moseley et al., 2015), while it was longer for patients undergoing surgical interventions as part of their management plan (mean 3.5 days) (Moseley et al., 2015).

In this paper, the data is aimed to be used to establish a structured standardized protocols of EMU admissions to improve the safety and the accuracy of the outcomes for the patient.

In our institution, a time-limited protocol for EMU admission was developed to utilize the limited available resources of the EMU in the KFSH&rc. Additionally, the protocol includes a checklist that closely monitors the



patients in EMU and keeps a record of the progress of the diagnosis of the patient's case.

Last but not least, more data is needed on the average LOS of patients in EMU and the effect of other variables on the length of stay for patients in EMU. Also, we suggest that more studies should explore the number of seizures needed to establish a diagnosis of the patient. As well as, the influence of the diagnosis on the age, frequency, and the number of seizures needed before establishing a diagnosis.

4. Conclusions:

Pre-admission clinical variables may predict EMU LOS. These factors could be used at the administrative level for maximum EMU resource utilization. The Clinical Pathway (CP) we established "Appendices" that are a general guideline and does not replace clinical judgment. Care should be individualized to meet the specific needs of each patient. The CP can, therefore, be deviated from when deemed appropriate with the reason documented.

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Appendices

The Clinical Pathway (CP):

Expected Length of Time on Stay: 10 days

Inclusion Criteria: All adult & pediatric patients admitted to Epilepsy Monitoring Unit (EMU) for video Electroencephalogram (VEEG).

Exclusion Criteria: Patients less than 1 year of age.
Patients with hair lice.

The Clinical Pathway (CP) is a general guideline and does not replace clinical judgment. Care should be individualized to meet the specific needs of each patient. The CP can therefore be deviated from when deemed appropriate with the reason documented.

DOCUMENTATION INSTRUCTIONS: Initial the appropriate aspect of care column Yes or No. If not applicable, enter N/A. No requires the reason documented below.

Day 1 Admission Day				DAY 2				DAY 3		DAY 4		Day 5					
DATE: / /	ASPECT OF CARE			DATE: / /	ASPECT OF CARE			DATE: / /	DATE: / /	DATE: / /	ASPECT OF CARE			DATE: / /	ASPECT OF CARE		
	YES	NO		YES	NO		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	
MD				MD				MD				MD					
History and physical examination completed				Discharge order entered									Discharge order entered				
EMU care set orders entered				Review and sign VEEG database									Review and sign VEEG database				
Explanation of plan of care to patient and family completed				Review medication plan									Review medication plan				
				Observe and document any seizure activity									Observe and document any seizure activity				
				Clipping VEEG on database									Clipping VEEG on database				
				Write VEEG note in the ICIS									Apply VEEG note in the ICIS				
													Order hygiene break				
NURSING				NURSING				NURSING				NURSING					
Patient is not infected with lice				Observe and document any seizure activity									Observe and document any seizure activity				
Start EMU nursing checklist				Maintain seizure precautions									Maintain seizure precautions				
Prepare patient for hookup				Keep IV access patent									Keep IV access patent				
Maintain seizure precautions				Check the head bandage									Check the head for any skin ulcer				
Establish IV access				Discharge medication ready									Prepare patient for hygiene break				
Educate the sitter about seizure precautions				Discharge appointment ready									Discharge medication ready				
Turn on nursing seizure observation monitor													Discharge appointment ready				
EMU TECHNOLOGIST				EMU TECHNOLOGIST				EMU TECHNOLOGIST				EMU TECHNOLOGIST					
Patient is not infected with lice				Archiving the VEEG row data									Archiving the VEEG row data				
Prepare the equipment and hookup the patient				Apply photic and hyper ventilation as per order									Apply photic and hyper ventilation as per order				
Ensure VEEG setup is functioning				Ensure VEEG setup is functioning									Ensure VEEG setup is functioning				
Apply Eyes opening/closing and awake record				Check the head bandage									Review and archiving the VEEG				
Start recording				Check head electrode									Apply hygiene break				
OUTCOMES				OUTCOMES				OUTCOMES				OUTCOMES					
Patient is prepared and connected to VEEG				Skin site around leads intact									Skin site around leads intact				
Medication plan is updated				Medication plan is updated									Medication plan is updated				
Patient seized				Patient seized									Patient seized				
				Patient ready for discharge / discharged									Hygiene break done				
													Patient ready for discharge /discharged				
DOCUMENTATION REASON:																	
NAME				I.D. NUMBER				TITLE				INITIAL					

Form Copy Distributions: White - Patient Chart, Pink - Quality Management, MBC # 19 **CLINICAL PATHWAY FOR EPILEPSY MONITORING UNIT**

Expected Length of Time on Stay: 10 day

Inclusion Criteria: All Patients admitted to EMU for video Electroencephalogram (VEEG) adult and pediatric.

Exclusion Criteria: Any patients less than 1 years of age, WITH HAIR LICE

The Clinical Pathway (CP) is a general guideline and does not replace clinical judgment. Care should be individualized to meet the specific needs of each patient. The CP can therefore be deviated from when deemed appropriate with the reason documented.

DOCUMENTATION INSTRUCTIONS: Initial the appropriate aspect of care column Yes or No. If not applicable, enter N/A. No requires the reason documented below.

DAY 6				DAY 7				DAY 8		DAY 9		Discharge Day					
DATE: / /	ASPECT OF CARE			DATE: / /	ASPECT OF CARE			DATE: / /	DATE: / /	DATE: / /	ASPECT OF CARE			DATE: / /	ASPECT OF CARE		
	YES	NO		YES	NO		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	
MD				MD				MD				MD					
Discharge order entered				Discharge order entered					Discharge order entered if the patient not due for discharge order hygiene break				Discharge order entered				
Review and sign VEEG database				Review and sign VEEG database					Review and sign VEEG database				To dictate the EMU report				
Review medication plan				Review medication plan					Review medication plan				To dictate discharge summary				
Observe and document any seizure activity				Observe and document any seizure activity					Observe and document any seizure activity								
Clipping VEEG on database				Clipping VEEG on database					Clipping VEEG on database								
Apply VEEG note in the ICIS				Apply VEEG note in the ICIS					Apply VEEG note in the ICIS								
Finalize discharge plan				Finalize discharge plan					Finalize discharge plan								
Discharge order completed				Discharge order completed					Discharge order completed								
NURSING				NURSING				NURSING				NURSING					
Observe and document any seizure activity				Observe and document any seizure activity					Observe and document any seizure activity				Remove IV access				
Maintain seizure precautions				Maintain seizure precautions					Maintain seizure precautions				Discharge appointment ready				
Keep IV access patent				Keep IV access patent					Keep IV access patent				Discharge medication ready				
Check the head bandage				Check the head bandage					Check the head bandage								
Discharge medication ready				Discharge medication ready					Discharge medication ready								
Discharge appointment ready				Discharge appointment ready					Discharge appointment ready								
EMU TECHNOLOGIST				EMU TECHNOLOGIST				EMU TECHNOLOGIST				EMU TECHNOLOGIST					
Archiving the VEEG row data				Archiving the VEEG row data					Archiving the VEEG row data				Archiving the VEEG row data				
Apply photic and hyper ventilation as per order				Apply photic and hyper ventilation as per order					Apply photic and hyper ventilation as per order				Discontinue VEEG as ordered				
Ensure VEEG setup is functioning				Ensure VEEG setup is functioning					Ensure VEEG setup is functioning								
Check the head bandage				Check the head bandage					Check the head bandage								
Check head electrode				Check head electrode					Check head electrode								
Discontinue VEEG as ordered				Discontinue VEEG as ordered					Discontinue VEEG as ordered								
OUTCOMES				OUTCOMES				OUTCOMES				OUTCOMES					
Skin site around leads intact				Skin site around leads intact					Skin site around leads intact				Patient discharged				
Medication plan is updated				Medication plan is updated					Medication plan is updated								
Patient seized				Patient seized					Patient seized								
Patient ready for discharge / discharged				Patient ready for discharge / discharged					Patient ready for discharge / discharged								
DOCUMENTATION REASON:																	
NAME				I.D. NUMBER				TITLE				INITIAL					

Form Copy Distributions: White - Patient Chart, Pink - Quality Management, MBC # 19 **CLINICAL PATHWAY FOR EPILEPSY MONITORING UNIT**