

# Inpatient Neurology Consultation Service in a tertiary care teaching hospital in Jordan: Effectiveness, Drug Utilization Pattern, and Cost

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## Abstract

In-hospital consultation (IHC) is a fundamental process at clinical institutions especially within tertiary care centers. We conducted a 3-months-prospective study to evaluate the neurology consultation service in terms of reasons for consult, outcomes retrieved, medication utilization pattern, and cost at a large teaching hospital in Jordan. A total of 199 patients had received in-patient neurology consultations (3 consultation/working day). Departments of internal medicine (47.7%) and neurosurgery (13.1%) made the majority of referrals. Common complaints which dictated consultations were: Preoperative evaluation of an already established neurological disease, focal weakness/ numbness, and decreased level of consciousness (16.6, 15.1, and 13.6). The largest proportion of outcomes retrieved from neurology consultation service was establishing new diagnosis for a neurologic disease (44.2 [29.6% acute and 14.6% chronic]). Regarding medication utilization pattern, additional medications were prescribed in 32.2% of patients while increasing dose was attempted in 8.5%. Levetiracetam was the most frequent medication to be added and also the most common medication which dose was increased. Time consumed per initial visit was at a median of 10 mins/patient (IQR: 8-15). Neurology consultation service yielded a significant contribution to diagnostic and management plan for patients. However, the process is costly and somehow time consuming.

**Keywords:** Neurology; consultations; cost; medication utilization pattern.

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## 1. Introduction

In-hospital consultation (IHC) is the process by which the primary care physician seeks advice from another subspecialty physician regarding the patient's diagnostic or management plans. It is becoming a cornerstone of clinical practice since the complexity and patient needs are escalating. In a one tertiary hospital, half of the hospitalized patients received at least one consultation (1). Neurological diseases contribute significantly to disability and death globally. Despite the considerable decrease in mortality rates following

neurological illnesses, the burden of which has increased substantially over the past 25 years due to expansion of population age and number. Thus, there is a pressing need for large number of clinicians with expertise in neurology to meet the expanding number of patients with neurological disorders (2).

Wide ranges of acute and chronic neurological issues are often managed by physicians and surgeons, especially those from medicine and cardiology (3). Neurological IPC is a way by which these physicians acquire

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support from neurologists optimizing the management of patients with presumable neurologic complains (4). The ultimate value for such consultations remains unclear because the costs and effectiveness of this process has not been subjected to adequate analyses yet. Neurologists might find the process time consuming and increasing workload. One study found that neurology IHCs increased time consumed and patients length of stay (1). Nevertheless, the significant contribution they make to enhance patient outcomes is undeniable as 83.6% of neurology consultations resulted in significant change in patient management in one study (5). Thus, there is an urgent need to evaluate this process in multi-disciplinary aspects to determine the strength of each facet of consultation service.

We aim, from this prospective audit, to evaluate the pattern of in-patient neurology consultation service including reasons for the consult, patient outcomes, medication utilization, cost, and time consumed per consult.

## 2. Materials and Methods

**2.1. Study design:** This is a detailed prospective descriptive three-month study of inpatient referrals to the neurology service undergoing in a tertiary care hospital at the north of Jordan. Institutional review board (IRB) approval was obtained before the commencement of data collection.

**2.2. Time:** From the beginning of January 2019 to the end of March 2019.

**2.3. Setting:** King Abdullah University Hospital (KAUH); a tertiary care hospital that can contain up to 819 beds and includes various medical and surgical subspecialties. It has an established neurology consultation service with 24-hour onsite neurology team. The neurology department consists of 6 consultants and 18

residents at various levels.

**2.4. Data collection:** Information collected were as following: Patient demographics and comorbidities, consulting team, reason of the consult, acuity of the neurological symptoms, time consumed, outcome of neurology consultations (new diagnosis of acute neurologic insult, new diagnosis of chronic neurologic insult, optimizing the treatment plan of already diagnosed neurological insult, no neurological insult), and medications prescription pattern through the consult (add, delete, change), investigations requested with its costs.

**2.5. Definitions:** Time consumed per consult was measured as the time consumed for taking medical history and examining the patient by the neurology resident at the first visit added to the time consumed during the round with the consultant.

**2.6. Statistical analysis:** Continuous variables were described by median  $\pm$  IQR, while categorical variables were presented as frequency and proportions (percentages). Descriptive statistics were performed using SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).

## 3. Results

A total of 199 patients whom we received consultations for during three months period, were at a median age of 53 (40-73). A round 3 consultations were received per one working day. **Table 1** demonstrates general characteristics of patients and consultations. Males accounted for 51.8% of our sample. Significant portion of patients had hypertension and diabetes (48.7% and 36.7%, respectively). Most consultations retrieved were due to acute neurological manifestations (67.3% versus 32.7% chronic) and were received during the

day shift (63.3% versus 36.7% on-call shift).

We measured the time consumed per consult for 189 patients. The median time consumed per initial visit was 10 minutes (IQR: 8-15 mins).

As shown in **Figure 1**, internal medicine and neurosurgery teams were the most specialties that requested neurology consultation services. Reasons for the consultations are displayed in **Table 2**. Preoperative evaluation, focal weakness or numbness, decreased level of consciousness (LOC), seizure, headache, and disorientation were the most common complaints behind consultations as listed in the table.

Neurology consultation service yielded new diagnosis of neurological insults in 44.2% of patients seen. A round 36% of patients received advice on their previously diagnosed neurological illness. Delirium was reported in 6% of patients. On the other hand, 12.1% of patients had no neurological cause of their complaints and diagnosis could not be reached in 2% as depicted in **Table 3**.

Regarding medication utilization pattern during the provision of neurology consultations, the most action done was adding medications (in 32.2% of patients). The most added medication was levetiracetam (25% of medications added). The second most common action done on medication use was increasing the dose of neurological medications (in 8.5% of patients). Levetiracetam was also the most common drug which dose is increased followed by sodium valproate as presented in **Table 4**. Deleting medications was done for 5.5% of patients seen. Phenytoin and aspirin were the most common two medications deleted during consultations.

Many investigations were requested throughout consultations (**Table 5**). Magnetic Resonance Imaging (MRI) for brain, Computed Tomography (CT) for brain, and Electroencephalography (EEG) were the most

common investigations requested (44.2%, 36.7%, and 20.6%). The total cost of all investigations ordered during consultations was \$37264.8.

#### 4. Discussion

Neurological diseases are debilitating in terms of death and disability (6). The burden of which is highly reflected on the quality of life of patients and their families (2). Analysis of in-patient neurology consultation patterns might assist in optimizing the efficiency of clinical practice. Our study is the first to examine neurology consultation service regionally and the first to evaluate medication utilization pattern throughout consultations. Our sample, composed from 199 patients whom median age was 58 years, revealed that internal medicine and neurosurgery were the most specialties that requested neurology consultations. Neurology consultation service resulted in a significant contribution to the diagnosis and therapeutic management plans among patients. However, it was associated with considerable costs and workload. This study has some limitations, it is only descriptive so no inferences can be obtained. Moreover, our study was performed during the winter season where stroke incidence is usually increased as previous studies reported so maybe stroke (within focal weakness/numbness category) are overestimated in our sample (7, 8).

Hypertension and diabetes were the most diagnosed comorbid diseases within patients we received consultations upon. These are a commonly encountered co-morbidities especially in Jordan (9, 10). Diabetes and hypertension are known risk factors for dementias and cerebrovascular events, especially if they were coexisted (11-13). Most requests were for preoperative evaluation, followed by focal weakness/ numbness, and

decreased LOC. In comparison, stroke was the most common reason for neurology consultations in three previous studies evaluating neurology consultation service (5, 14, 15). We believe that preoperative evaluation of chronic neurologic medications and others should be devoted to the surgery department. This might warrant awareness and educational programs to prevent untoward calls for consultations. The second most common cause for consults, focal weakness or numbness, was almost exclusively related to stroke.

In our analyses, neurology consultations resulted in establishing new diagnosis in 44.2% of patients and providing advice on a previously diagnosed neurological disease in 35.7%. in one center in United Kingdom, new diagnosis was also the most outcome yielded from consultations at comparable percentage (35.8%) (14). Same findings were concluded in a tertiary center at Ireland (40.7%) (16). However, in our study no neurologic cause was found in 12.1%. This is considerable proportion when comparing it to other centers where no definitive contribution was only 5.8% (14). This also dictates promotion of awareness campaigns about when to call a neurologist. Providing advice on a previously diagnosed neurological disease was not always of big benefit to the patient.

We evaluated the pattern of medication utilization throughout neurology consultations, adding medications was the most utilized action with a proportion of 32.2%. Levetiracetam accounted for 25% of added medications (10.6% of patients). In a previous study at Spain, levetiracetam was also the most prescribed drug throughout neurology consultations in 4.7% of patients. Phenytoin and aspirin were added in 3.5% of patients and deleted in 1.5% of patients. They were the most deleted medications among our sample. Another part of the significant

contribution neurologists made during consultations was adjusting doses of previously prescribed medications. Increasing doses of medications was attempted in 8.5% of our sample. Levetiracetam was the most medication which dose is increased (42.2% of medications of which dose is increased), followed by sodium valproate.

Regarding investigations requested, brain MRI, brain CT, and EEG were the highest requested investigations by neurologists to evaluated patients consulted for. At another center, EEG was the most frequently requested diagnostic test (23.1%), followed by CT brain, SAT/transcranial echo-Doppler, and brain MRI; respectively. Investigations were costly as it contributed to paying \$37264.8 in three months.

**5. Conclusion:** Our findings highlight the clear beneficial impact of neurology consultation service on the clinical practice and management plans. However, awareness programs should be directed to other residents of the hospital, especially the departments which frequently order neurological consultations, to delineate when and how the neurologists can be approached as they already have significant other work duties such as managing the healthcare of inpatient, outpatient, and acute cases in the emergency department besides their academic requirements.. If awareness programs failed to reduce the number and time consumed in consultations, this may dictate a rise in neurologists' workforce and increase in resources and service re-organization to decrease the workload on neurologists.

## 6. Acknowledgments

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## 7. Competing interests

Authors declare that they have no financial/personal interest or belief that could affect the results of this study.

### 8. Contributorship

all authors have contributed sufficiently to the manuscript and have approved the final

version of the manuscript.

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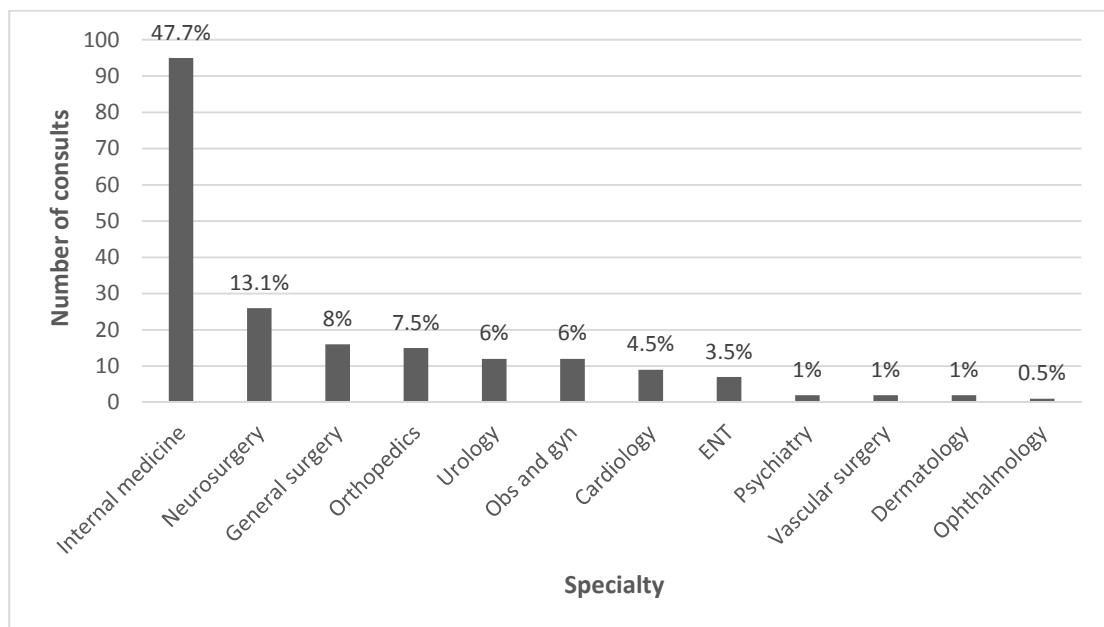


Figure 1: Consulting teams for the neurology consultation service. Abbreviations: ENT, ears, nose, and throat.

Table 1: Subjects and consultations characteristics (n=199)

Characteristic	Number (%)
Age (median, IQR)	58 (40-73)
Gender	
Female	96 (48.2)
Male	103 (51.8)
Most existing comorbid diseases	
Hypertension	97 (48.7)
Diabetes	73 (36.7)
IHD	31 (15.6)
Stroke	29 (14.6)
Seizure	29 (14.6)
CKD	18 (9)
HF	11 (5.5)
AF	8 (4)

Asthma	8 (4)
<b>Cause</b>	
Acute	134 (67.3)
Chronic	65 (32.7)
<b>Consulting time</b>	
During the day	126 (63.3)
During the on-call shift	73 (36.7)
<b>Time consumed in mins (median, IQR)<sup>a</sup></b>	10 (8-15)

a: missing data (10)

**Abbreviations:** AF, atrial fibrillation; CKD, chronic kidney disease; HF, heart failure; IHD, ischemic heart disease; IQR, interquartile range.

**Table 2: Reasons of the neurology consultation service**

Cause	Number (%)
Preoperative evaluation of patients already diagnosed with neurological insult	33 (16.6)
Focal weakness/numbness	30 (15.1)
Decreased LOC	27 (13.6)
Seizure	22 (11.1)
Headache	11 (5.5)
Disorientation	10 (5)
Dysarthria	9 (4.5)
Abnormal movement	7 (3.5)
Vertigo	7 (3.5)
Dysphagia	5 (2.5)
Numbness	5 (2.5)
To rule out stroke	5 (2.5)
Optimize medication use for neurologic disease	4 (2)
To rule out meningitis	3 (1.5)
Memory changes	3 (1.5)
<b>Others<sup>a</sup></b>	18 (9)

a: other reasons were as follows: stridor, loss of vision (2), limb pain, progressive muscle weakness, parkinsonism, not following commands, neck pain and urinary incontinence, inability to talk, general weakness, agitation, abnormal posture, rule out seizure (2), unsteadiness (2), abnormal findings on imaging (2).

**Abbreviations:** LOC, level of consciousness.

**Table 3: Outcomes of the neurology consultation service**

Outcome	Number (%)
Advice on an already diagnosed neurological disease	71 (35.7)
Diagnosis of acute neurologic disease	59 (29.6)
Diagnosis of chronic neurologic disease	29 (14.6)
No neurological insult	24 (12.1)
Delirium	12 (6)
Diagnosis couldn't be reached	4 (2)

**Table 4: Drug utilization throughout neurology consultation services**

Action done on medications	Number (%)
<b>Medications added (%)<sup>a</sup></b>	64 (32.2)
Levetiracetam	21 (25)
Atorvastatin	8 (9.5)
Phenytoin	7 (8.3)
Aspirin	7 (8.3)
Sodium valproate	6 (7.1)
Antibiotics <sup>b</sup>	6 (7.1)
Midazolam	4 (4.8)
Clopidogrel	3 (3.6)
Warfarin	3 (3.6)
Betahistine	3 (3.6)
Analgesics	3 (3.6)
Levodopa/Carbidopa	2 (2.4)
Baclofen	2 (2.4)
Clonazepam	1 (1.2)
Propofol	1 (1.2)
Ketamine	1 (1.2)
Gabapentin	1 (1.2)
Haloperidol	1 (1.2)
Amitriptyline	1 (1.2)
Dexamethasone	1 (1.2)
<b>Medications deleted (%)<sup>a</sup></b>	11 (5.5)
Phenytoin	3 (27.3)
Aspirin	3 (27.3)
Olanzapine	1 (9.1)
Clopidogril	1 (9.1)
Sodium valproate	1 (9.1)
Carbamazepine	2 (18.2)
<b>Medications of which dose is increased (%)<sup>a</sup></b>	17 (8.5)
Levetiracetam	7 (42.2)
Sodium valproate	4 (23.5)
Phenytoin	1 (5.9)
Atorvastatin	1 (5.9)
Rivastigmine	1 (5.9)
Acetazolamide	1 (5.9)
Gabapentin	1 (5.9)
Amitryptaline	1 (5.9)

**a:** Percentage of medications within category not within all sample.

**b:** Antibiotics prescribed for meningitis were: antiTB antibiotics (1) [isoniazid, rifampin, ethambutol, pyrazinamide], meropenem (2), vancomycin (2), ceftriaxone (1).

**Table 5: Investigations requested throughout neurology consultations and their presumed cost.**

Investigations requested	Number (%)	Cost per investigation (US \$)	Total cost
<b>CT Brain</b>	73 (36.7)	70.7	5160.078
<b>CT NCAP</b>	1 (0.5)	192.8	192.78
<b>CT Pelvic</b>	1 (0.5)	53.6	53.55
<b>CTA Brain and neck</b>	3 (1.5)	107.1	321.3
<b>CTV</b>	1 (0.5)	71.4	71.4
<b>MRI Brain</b>	88 (44.2)	176.8	15557.2
<b>MRI Brain with contrast</b>	6 (3)	176.8	1060.718
<b>MRI Whole spine</b>	2 (1)	685.4	1370.88
<b>MRI Whole spine with contrast</b>	1 (0.5)	706.9	706.86
<b>MRI Cervical, thoracic, or lumbar</b>	9 (4.5)	171.4	1542.24
<b>MRV Brain</b>	1 (0.5)	176.8	176.7864
<b>MRA Brain and neck</b>	18 (9)	342.7	6168.96
<b>EEG</b>	41 (20.6)	71.4	2927.4
<b>EMG</b>	8 (4)	128.5	1028.16
<b>PET scan</b>	1 (0.5)	856.8	856.8
<b>US Carotid</b>	1 (0.5)	69.7	69.6864
<b>Total</b>	-	-	<b>37264.8</b>

**Abbreviations:** **CT**, Computed Tomography; **CTA**, Computed Tomographic Angiography; **CTV**, Computed Tomographic Venography; **EEG**, Electroencephalography; **EMG**, Electromyography; **MRA**, Magnetic Resonance Angiography; **MRI**, Magnetic Resonance Imaging; **MRV**, Magnetic Resonance Venography; **NCAP**, Neck/Chest/Abdomen/Pelvis; **PET**, positron emission tomography; **US**, ultrasound.

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## خدمة استشارة فريق الأعصاب في مستشفى متخصص في الأردن: الفعالية، نمط استخدام الأدوية، و التكلفة

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### الملخص

خدمة الاستشارات داخل المستشفى هي عملية أساسية في المستشفيات السريرية خاصة داخل المستشفيات من المستوى الثالث. أجرينا دراسة استطلاعية لمدة ثلاثة أشهر لتقدير خدمة استشارة أطباء أمراض الدماغ والأعصاب من حيث أسباب الاستشارة، النتائج من الاستشارة، نمط استخدام الأدوية، والتكلفة في مستشفى تعليمي كبير في الأردن. تلقى ما مجموعه 199 مريضاً استشارات لأطباء الأعصاب أثناء مكوثهم في المستشفى بما يعادل 3 استشارات لكل يوم عمل. غالبية الاستشارات كانت من قسم الباطني (7,7%) وقسم جراحة الدماغ والأعصاب (13,1%). أغلب أسباب الاستشارات كانت: تقييم ما قبل التدخل الجراحي لمرض عصبي مشخص مسبقاً، وجود ضعف أو خدر موضعي وانخفاض مستوى الوعي (13,6% ، 16,6% ، 15,1%). أما بالنسبة لنتائج الاستشارات فكانت أعلى نسبة لتشخيص جديد لمرض عصبي (44,2% 29,6% 14,6% مزمن). فيما يتعلق بنمط استخدام الأدوية تم إضافة أدوية جديدة للمرضى فيما نسبته 32,2%، وتمت زيادة جرعة أدوية موصوفة مسبقاً في 8,5%. دواء ليفيتيراسيتام كان الأكثر إضافة بين الأدوية، والأكثر زيادة في الجرعة. وكان معدل الوقت المستغرق للزيارة الأولى للمريض 10 دقائق لكل مريض (مدى بين الريعي 8-15 دقيقة). أسهمت خدمة استشارة أطباء أمراض الدماغ والأعصاب مساهمة كبيرة في تشخيص وعلاج المرضى ولكنها تعتبر عملية مكلفة وتستغرق وقتاً كبيراً.

**الكلمات الدالة:** العلوم العصبية، الاستشارات، التكلفة، نمط استخدام الأدوية.