ORIGINAL ARTICLE

A Study on the Diagnostic Discrepancy between Admission and Discharge in Hospital Universiti Sains Malaysia

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ABSTRACT

Introduction: Accurate provisional diagnosis in the Emergency Department (ED) is important as it has a significant impact on safety. It also affects the patients' treatment, length of stay and cost of treatment. The data on the accuracy of making diagnosis made by ED doctors is scarce and most results vary with different countries. This study was conducted to evaluate the accuracy of the diagnosis made by the ED doctors in Hospital Universiti Sains Malaysia (USM) and the factors contributed to the discrepancy. **Method:** This was a retrospective cross-sectional study conducted in Hospital USM from May 2016 to December 2017. Medical records of the patients who were admitted to the hospital were selected using simple random sampling methods. The folders were reviewed and the association within the categorised diagnosis accuracy was analysed using the ICD-10 classification. The sample size was 180 cases, and cases were divided into two main categories. The factors associated with the unmatched diagnosis from both patients and provider were then measured using multiple logistic regressions. **Results:** Hospital USM Emergency Department had 15.6 per cent of unmatched diagnosis and 84.4 per cent of matched diagnosis. No difference between age and gender in making accurate diagnosis. The odds of having unmatched diagnosis in patients from the green zone are 4.2 times higher compared to the red zone. **Conclusion:** ED Hospital USM has a high diagnostic accuracy, especially involving the patients in red zone and yellow zone.

Keywords: Diagnostic discrepancy, Diagnosis, Emergency department, Patient safety

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INTRODUCTION

The perception of other specialties towards Emergency Medicine was complex as it started way back in 1979 as the 23rd specialties (1). The Emergency Medicine specialty in Malaysia started in 1998 and before that, the Emergency Department (ED) was managed by medical officers (MO) and had no dedicated attending specialist. It was considered as a "dumping site" to MOs that were problematic and those who had no clear pathway to further their study in any specialties (2).

Since the inception of a new specialty set in the late 1990s, it has made significant changes in the management of undifferentiated patients and training for the MOs in the ED. Though many changes have been made, it is always perceived as the department that is not able to be relied on. As the years progress, the specialty of Emergency Medicine has been expanding and to date, it is among the most applied specialty for post-graduate training in Malaysia.

One of the critical debates within the inter-specialties in hospitals around Malaysia is regarding the competency of the ED to make an accurate diagnosis before admission of the patients and further management by the primary team (3). There are two types of admission that are being practiced in the country. In most of the hospitals in Malaysia, the receiving team has to vet the admission, either by reviewing the patient at the ED or through a phone call. However, in some hospitals, direct admissions from the EDs are practiced.

In the setting where every case needs to be vetted by the receiving team, the management and flow of the patient

in the ED are affected due to prolonged stay in ED that will lead to access block (4). Therefore, this will also lead to reduce of the quality of care in ED (5).

Multiple studies show the variation of the results for diagnostic accuracies, ranging from 43.3% to 93.5% (3,5,6). However, El-Mahhali et al. (7) from Hospital King Saudi Arabia, Egypt recorded that the accuracy of diagnosis during admission from the ED is only around 65.3%. This discrepancy may be due to the availability of medical staffs, investigations, the medical practice itself and robustness of the medical training. The workload variability in different centres and the pressure of time on making a diagnosis may contribute to this variation (8). Diagnostic discrepancy also being studied between physician-staffed Emergency Medical Teams in prehospital care with hospital diagnosis to emphasize the importance of accurate diagnosis (9).

The need for diagnostic accuracy in ED is vital as it affects patients' care, the prognosis of the patients, financial and legal implications. This also leads to a high level of satisfaction and indirectly reducing the revisit to ED and burden to the health sectors (6, 10-12). It also indicates a high-quality work of the treating doctors (13). However, this is among the understudied topic in emergency medicine (14).

Hospital Universiti Sains Malaysia (USM) is a tertiary hospital in the state of Kelantan, Malaysia. It caters most of the cases, especially medical, surgical, paediatric surgery, cardiothoracic surgery, neurosurgery, neuro medical, obstetrics and gynaecology, paediatrics, psychiatric, and orthopaedic. It is the only referral centre for all neurosurgery and neuro medical cases throughout the state and the northern part of Terengganu. Therefore, this study aims to compare the accuracy of the ED diagnosis during admission to the discharge diagnosis

by the primary team. Patients associated factors and providers related factors that contribute to the discrepancy of the diagnoses are also determined.

MATERIALS AND METHODS

A retrospective cross-sectional study was conducted in ED Hospital USM from June 2016 to August 2017. Patients who were admitted to Hospital USM from ED were included in the study. In 2016, the numbers of the patient presented to ED was 65,908 patients throughout the year (15). All the cases presented in ED were documented in the ED census book which was kept on a monthly basis. From a total of 14 months, we randomly chose 15 cases per month through ED census book by using a random number generator (16). The first 15 cases that were admitted from the ED using the sequence number that was generated were traced from the Record Unit and were enrolled in the study provided there were no exclusion criteria. The exclusion criteria for the cases are terminally ill and palliative patients, referral cases from another tertiary hospital for a continuation of care, out-of-hospital cardiac arrest, incomplete data and any direct admission from district hospitals or clinics that went through ED. Ethical approval for this study was obtained from Human Research Ethics Committee USM USM/JEPeM/16040160.

For sample size calculation, we used single proportion formula based on primary objective with proportion of unmatched diagnosis by El-Mahalli and Mokhtar 2009 (7). With additional 20% expected drop-out rate, the final calculated sample size was 180. Therefore, a total of 180 cases were selected and the folders were traced. These folders were reviewed, and the final diagnosis made from the ED before the referral was taken and compared to the definitive discharge diagnosis. Patients' demographic data, triage, time of arrival, numbers of co-morbidities, numbers of investigations done, numbers of referral done and the length of stay, the diagnosis of the emergency department before referral and the discharge diagnosis were collected.

These data were categorised into two major groups that were modified based on the previous study done by El-Mahalli et al. (7) that are matched diagnosis and unmatched diagnosis.

1. Matched Diagnosis includes:

a) "Fully matched" diagnosis: if the ED diagnosis was the same as the final discharge diagnosis based on the ICD-10-CM coding.
b) "Partially matched" diagnosis: if the ED diagnosis and final discharge diagnosis belonged to the same broad diagnostic grouping according to the ICD-10-CM, three digits classification.

2. Unmatched Diagnosis includes:

a) ''Unmatched'' diagnosis: if admission diagnosis and final discharge diagnosis were different and unrelated.
b) "Missed" diagnosis: if there was no specific diagnosis in the ED sheet, but only the symptoms were documented e.g. giddiness, chest pain, vomiting etc.

Statistical analysis was done using Statistical Packages for Social Science (SPSS) version 22.0. Descriptive analysis was expressed in frequencies and percentage for categorical variables. Means and standard deviation are shown in numerical variables. For the primary objective, the report was presented as descriptive analysis and the rest of the objectives were analysed using multiple logistic regression.

RESULTS

From 180 cases that were admitted through ED Hospital

USM, 152 out of 180 cases (84.4%) had matched diagnosis and 28 cases (15.6 %) had an unmatched diagnosis. The gender is almost equally distributed between male and female and the mean age of the cases is 38 (SD±25.7) years old. Less than half of the patients (45.6%) have no underlying medical condition and both matched and unmatched diagnosis has the highest number in those who had no previous medical illness. Majority of the cases presented during evening (PM) shift (3 pm until 10 pm) and both the morning (AM) shift (8.00 am until 3 pm) and night shift (ON) have a similar percentage (28.3%). Among the cases presented, 48.9% triaged into the yellow zone and the patients presented to yellow zone show a high degree of unmatched diagnosis. For the number of referral unit that was involved, most of the cases had only one referral unit which accounts for 93.3%. Only 11.1% of the cases had to be referred to the critical care unit. The mean numbers of investigations are 5.51 with a standard deviation of 2.3 (Table I).

Table I: Sociodemographic data

Variables	Matched diagnosis	Unmatched diagnosis	Total Cases
	n (%)	n (%)	n (%)
Gender			
Male	77 (50.7)	9 (32.1)	86 (47.8)
Female	75 (49.3)	19 (67.9)	94 (52.2)
Age	39.1 (26.0)*	29.0 (22.5)*	38 (25.7)*
Minimum			1 month
Maximum			80 years
Underlying Medical Condition			
NKMI	70 (46.1)	12 (42.9)	82 (45.6)
1	33 (21.7)	10 (35.7)	43 (23.9)
2	19 (12.5)	1 (3.6)	20 (11.1)
>3	30 (19.7)	5 (17.8)	35 (19.4)
Time of Presentation			
AM	44 (28.9)	7 (25)	51 (28.3)
PM	65 (42.8)	13 (46.4)	78 (43.4)
ON	43 (28.3)	8 (28.6)	51 (28.3)
Triage Zone			
Green	22 (14.5)	3 (10.7)	25 (13.9)
Yellow	67 (44.1)	21 (75.0)	88 (48.9)
Red	63 (41.4)	4 (14.3)	67 (37.2)
Numbers of Referrals			
1	141 (92.7)	27 (96.4)	168 (93.3)
2	7 (4.6)	-	7 (3.9)
3	3 (2.0)	-	3 (1.7)
4	1 (0.7)	1 (3.6)	2 (1.1)
Critical Care Referrals			
Yes	17 (11.2)	3 (10.7)	20 (11.1)
No	135 (88.8)	25 (89.3)	160 (88.9)
Investigations	5.51 (2.3)*	5.46 (2.28)*	
Total	152 (84.44)	28 (15.56)	180 (100)

* Mean (SD)
NKMI - No known medical illness

Table II shows the list of unmatched diagnosis that shows 46.4% of the cases are infection- related while coronary and trauma-related cases had 14.2% each. The rest of the cases which account for 25.2% of the unmatched diagnosis includes gynaecology, immunology, urology, orthopaedics, endocrine and psychiatric cases.

Table III shows factors that are associated with unmatched diagnosis based on the univariate analysis.

Table II: Admission and discharge diagnosis difference in unmatched diagnosis category

Admission diagnosis	Discharge diagnosis
Acute coronary syndrome	Electrical storm in AICD with Brugada syndrome
Acute coronary syndrome	Uncontrolled hypertension unlikely ACS
Acute fever for investigations	Parainfluenza croup with secondary bacterial infection
Acute SLE flare	Seborrheic dermatitis and fungal infections
AGE	Constipation colic
AGE with mild dehydration	Acute tonsillopharyngitis
AGE with poor oral intake	Urinary tract infection
Alleged fall with cerebral oedema	Cerebral concussion, no cerebral oedema
Cerebral concussion, unlikely intraabdominal injury	Liver injury grade II
Dengue fever with warning signs	Atypical pneumonia with clinical leptospirosis
Ectopic pregnancy	Uterine pregnancy with threatened miscarriage
Fluid overload secondary to acute coronary syndrome	HAP
Fluid overload secondary to CCF	Complex cyanotic heart disease
HAP	Labile mood secondary to SLE
Intraabdominal sepsis	Clinical typhoid fever
Left renal colic	Twisted left ovarian cyst
No diagnosis	MVA with severe head injury
Open fracture left tibia fibula	Deep laceration wound of left leg
Prolonged fever with pleural effusion	PTB smear negative with pleural tuberculosis
Reduced urine output for investigations	UTI with AUR due to neurogenic bladder secondary to myelomeningocele
Schizophrenia	Bipolar I disorder
Spondylolisthesis	L4/L5 pars interarticularis fracture
Symptomatic hypoglycaemia	Meningitis with electrolyte imbalance
Threatened miscarriage	Early intrauterine pregnancy
To rule out occult sepsis	Right lung abscess
Urinary tract infection	E-coli bacteraemia secondary to CAP
Urinary tract infection	Unstable angina
Viral fever with recurrent vomiting	Acute tonsillopharyngitis

AGE - Acute gastroenteritis, AICD – Automated implantable cardiac defibrillator, SLE – Systemic lupus erythematous, HAP – Hospital acquired pneumonia, CCF – Congestive cardiac failure, ACS –Acute coronary syndrome, MVA – Motor vehicle accident, PTB - Pulmonary tuberculosis, UTI – Urinary tract infection, AUR – Acute urinary retention, CAP – Community acquired pneumonia

To determine the significant factors, level of significant was set at 2 tailed p-value of < 0.25. Based on these findings, the significant relationship in unmatched diagnosis were age, gender and triage zone and were put into the multivariate model. Therefore, based on multiple logistic regression analysis (Table IV), only the triage zone showed significant result (p = 0.013). For patients in green zone, there were 4.201 higher odds to experience unmatched diagnosis compared to patients in red zone (b = 1.435, OR (95% CI) = 4.201 (1.345,13.121).

Table III: Simple logistic regression for factors associated with unmatched diagnosis

Variables	B	Crude OR (95% CI)	p-value
Age	-0.16	0.984 (0.968,1.001)	0.059
Gender			
Male		1.00	
Female	-0.774	0.076 (0.196,1.084)	0.076
No. of co-morbidity			
NKMI		1.00	
1	0.028	1.029 (0.333,3.176)	0.961
2	0.598	1.818 (0.558,5.928)	0.321
≥ 3	-1.153	0.316 (0.034,2.915)	0.309
Time of presentation			
AM		1.00	
PM	-0.157	0.855 (0.285,2.564)	0.780
ON	0.072	0.883 (0.411,2.811)	1.075
Triage zone			
Green Zone		1.00	
Yellow Zone	0.832	2.299 (0.625,8.451)	0.210
Red Zone	-0.764	0.466 (0.097,2.246)	0.341
Investigations	-0.009	0.991 (0.8321.180)	0.918
No. of referrals	0.010	1.010 (0.407,2.503)	
Length of stay	-0.029	0.971 (0.910,1.036)	0.371

NKMI – no known medical illness

Table IV: Multiple logistic regression for factors associated with unmatched diagnosis

Variables	B	Adjusted OR (95%CI)	p-value
Gender			
Male		1.00	
Female	0.678	0.986(0.809,4.798)	0.113
Age	-0.014	0.986(0.969,1.003)	0.136
Triage Zone			
Red		1.00	
Yellow	0.685	1.983(0.399,9.856)	0.403
Green	1.435	4.201(1.345,13.121)	0.013

Classification table 84.4% correctly classified
Interaction term checked – no interaction found
Hosmer Lemeshow test, p-value = 0.955
Area under Receiver Operating Characteristic (ROC) curve was 0.722

DISCUSSION

Diagnosing undifferentiated patients in the ED is always challenging (17). The importance of making an accurate diagnosis is crucial for the treatment of a patient. A wrong diagnosis at the start, especially in ED can cause devastating failure to the patient's management, causing more harm to the current patient's state. Inaccurate diagnoses correlated with worse outcomes in all quality indexes that measures morbidity and mortality in one of the studies (14). Increased length of hospital stay is also a consequence (18).

In our study, we found that the ED in Hospital USM had a relatively high diagnostic accuracy of 84.4%. In comparison with the previous research, Chattopadhyay et al. (10) documented 43.3% diagnostic accuracy in a study held in Kalkutta, India. In Egypt, El-Mahalli et al. (7) showed 62.3% diagnostic accuracy made by ED. A study in Singapore showed a diagnostic accuracy of 86.7% while the highest accuracy documented was from Turkey by Hassan Amiri et al. (5) that showed 97.2% accurate diagnosis made in ED setting (2).

The ED of Hospital USM is a well-established training centre and started its postgraduate training since 1998. Before enrolment into the postgraduate training, most of the MOs in ED Hospital USM have served other Ministry of Health hospital for three to five years. Upon reaching a registrar position, they usually have seven to ten years of experiences. Other than that, being the teaching and tertiary centre, ED of Hospital USM is well-equipped with bedside investigations, excellent facilities and specialists' coverage. These may contribute towards the high diagnostic accuracy made at the ED (16).

The only significant finding in this study is that the odds of getting an unmatched diagnosis in the green zone in 4.2 times higher compared to the red zone. The previous study did not examine the differences between the zone of the patients. However, research done by El- Mahalli et al. had compared either the patient being assessed at triage or not. In that study, they noted that more than half (52.8%) of the patient who passed through triage had fully matched diagnosis, compared to those who did not pass through the triage counter (7).

In our settings, the green zone is where stable and non–critical patients are seen. There are four rooms and this zone are mostly taken care of by the junior MOs or the first-year postgraduate students in Emergency Medicine. There are no dedicated registrars or specialists that will be on the floor all the time covering the green zone. The MOs will consult the registrar or specialist if they have difficulty in diagnosis, investigation, treatment or admissions. This zone has a higher turnover patient compared to other two zones. Due to this high turnover rate, the time for each patient is limited and numbers of investigations in this zone are relatively less compared to other zones. A study done in 1984 by Trautlein et al. claims that misdiagnosis in ED is mostly contributed by failure to examine appropriately, failure to order proper diagnostic studies, failure to interpret x-rays and other diagnostic studies (19). In Netherlands, most of the claims made from ED are for minor injuries such as ankle injuries (20). Cognitive slips and overconfidence with their diagnoses may also contribute to inaccurate diagnosis in green zone where most patients appear stable and non-critical (21).

Atypical presentation is another challenge in any ED. It has been recognised that elderly, female, underlying diabetes mellitus and physically or mentally challenged patients may have a higher atypical presentation in some diseases (17). Our study shows that female gender does not contribute towards the unmatched diagnosis, that

was initially thought as a reflection by an atypical presentation. This finding is comparable with two other studies that showed no significant results of gender in making an accurate diagnosis (6,8). One study by Chiu et al. shows that significant higher accuracy in the male gender and non-geriatric patients (<65 years) on which 77.4% accuracy compared to the geriatric patient who had 67.1% ($p < 0.001$) diagnosis accuracy (22). Another study also showed that male and older patients had higher accuracy of diagnosis (14).

El-Mahalli et al. (7) showed unmatched diagnosis was higher during the night shift (18.9%) comparatively to the morning (8.1%) and evening (8.6%). However, our study shows no significance in the time of presentation of the patients to the ED of Hospital USM. Other factors include triage zone, the number of investigations, the number of referral and length of stay also show no significant results. Mean numbers of investigations done were 5.51 with a standard deviation of 2.3. A study in Kalkutta, India by Chattopadhyay noted that the mean number of investigations done at the centre was seven including biochemistry, radiological, cardiology and others (10). Another study found that there is no statistical significance between the number of investigations towards the accuracy of the diagnosis (7). In Hospital USM, the most frequent investigations done in ED were full blood count (FBC), renal profile (RP), liver function test (LFT), electrocardiogram (ECG) and capillary blood sugar (CBS). Chiu et al. noted that patient with chest x-ray and ECG done in ED shows higher accuracy among those admitted into medical ward while among admission to the paediatric department, those who had blood investigations done in ED shows significantly associated with matched diagnosis (22). Other associated factors involving the providers also show no significant results in this study. However, another study in Calcutta showed that increased numbers of stay (>7days) were associated with an unmatched diagnosis which accounts for 75.9% of the total number of unmatched diagnosis cases (10).

Among the unmatched diagnosis, the majority of the cases were among patients with underlying infections which is comparable with one of the studies (14). Out of 23 unmatched diagnosis, thirteen cases were infections related. Some of the unmatched diagnosis had no proper diagnosis in the emergency clerking sheets like prolonged fever or reduce urine output. It is understood that infection related cases need precise diagnosis from blood investigations and culture where internal medicine MOs have more advantage on focusing this preselected patient population (18). Moreover, some patients may come with non-specific complaint like malaise and fever that contribute to inaccurate diagnosis (23).

Most of the acute coronary syndrome (ACS) cases were diagnosed correctly. However, only two cases in which were diagnosed as ACS in ED but turned out to be different diagnoses. Other diagnoses that had high diagnostic accuracy include those in the neurosurgical, neuro medical and orthopaedics team in which the radiological findings supported most of this diagnosis. Comparatively, Amiri et al. shows 100% accuracy in neurosurgery cases, 93.3% accuracy in internal medicine and 88.6% of diagnosis accuracy in infectious disease (5). In North General Hospital from Hong Kong, showed among numbers of unmatched diagnosis, general medicine had a higher number of cases followed by surgery and neurosurgery cases (22). El Mahalli et al. noted higher percentages of accuracy in paediatric and obstetrics and gynaecology department, while the internal medicine department has the lowest accuracy rate which accounts for 53.9 percent (7).

CONCLUSION

ED Hospital USM has a high diagnostic accuracy. However, the green zone had 4.2 higher odds of making unmatched diagnosis compared to the red zone. Placing a senior medical officer in the green zone is recommended to monitor and assist in establishing accurate diagnosis.

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