ORIGINAL

OBSERVATION OF EMERGENCY ROOM LENGTH STAY OF PATIENTS SUFFERING FROM SPORTS INJURIES RECOMMENDATIONS FOR IMPROVING HOSPITAL STAY

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ABSTRACT

With the increased number of sports injuries over the year, the emergency departments of various countries witnessed enormous challenges related to patient management and duration of stay at the hospital. These concerns drew attention to factors that highly impact the length of stay and observation period in emergency departments. The study's main objective was to evaluate the organizational or institutional factors that control the length of stay (LOS) at physical rehabilitation and surgical centers. The results identified that the factors, i.e., delayed lab reports, bed management, and the treatment or diagnosis approach, determine the patient's observatory time and treatment outcomes. The role of the Clinical Decision Support system (CDSS) was examined to evaluate the differential impact of management measures on inpatient recovery and improved LOS.

KEYWORDS: Sports Injuries, LOS, Clinical Decision support system

INTRODUCTION

It is observed that sports-related activities are subjecting youth and children to severe injury mechanisms. The NHS England Hospital Episode Statistics, indicate that 1.9% of emergency department attendees and 7.7% of sports injury inpatients were recorded by emergency departments in the last few years (Vishnubala et al., 2020). Injury data provided by the Oxfordshire NHS emergency department also revealed that the number of sports-injured attendees was twice there compared to those observed in the NHS record (Kirkwood et al., 2017). As the emergency medical cost includes physiotherapist treatments, medicines, and surgical procedures, the cost can be reduced or maintained by employing smart strategies in the emergency

rooms (Ryan et al., 2019). Following insightful measures, advanced technologies, and strategic management can reduce patients' emergency stay and their medical budget. The emergency room characteristics and management is highly associated with the length of stay and hospital charges. As highlighted by Yang et al.(Yang et al., 2007), annual youth sports injuries cost between $113 and $133 million in the USA, which is a serious concern. In this study, the researcher analyzed the injuries nature and their respective percentage of inpatients, their management, emergency room, and lab accessories superintendence, i.e., bed allotment, lab results, and follow-up procedures to examine the emergency stay duration of physically injured patients. Length of stay in observation is a measurement tool developed for the length of stay of patients hospitalized in the Emergency Service. It is aimed to increase the efficiency and effectiveness of service delivery in emergency services and to ensure patient safety (Tetik, 2020). This observational study aims at examining the effectiveness of emergency services while monitoring the duration of physically injured inpatients stay. It is important to pre-understand the factors that prolong the emergency stay of patients. The prolongation of the medical process at initial stage also evoke some serious concerns which are given below:

• Increase in patient density
• Decrease in efficiency and effectiveness of health service delivery.
• Putting patient safety at risk
• Delaying the main and permanent treatment process (prolongation of transfers to clinics)
• Improper isolation also increases the risk of contamination.

The delayed and prolonged length of stay impacts patients' medical conditions and harms healthcare or medical expenditures. The main contributors to the utilization and expenditure are the provision of initial healthcare services (Attrill et al., 2018; Nghiem & Connelly, 2017). It is estimated that sports injuries cost $24 million for inpatient care and $87 million for emergency department services (Ryan et al., 2019). Therefore, the increased cost of sports injuries draws our attention to the factors that affect initial medical services. This can be reduced by cost-effective medical programs, smart medical measures, and organizational strategies to manage inpatient stays and costs (Heimann et al., 2018; Pottle, 2019). The Australian sports commission presented a report in 2020 that demonstrates the hospital spending related to hospital admissions and the emergency department. As per the report, physical-activity-related injuries cost $164 million in the emergency departments. The report also outlined the injury types and their cost variation. According to their data, physical sports-related injuries cost $51 million more than other fractures and soft-tissue injuries, which are reportedly $45 and $32 million (Health & Welfare, 2022). The preliminary injuries budget is significantly associated with organizational management, service quality, and patient stay in the observation room (McCoy & Das, 2017). All these factors collectively determine the patient's long-term health risks and improvements (Salway et al., 2017). Due to these indicators' significance, they are considered while measuring the LOS of physically injured patients and designing LOS improvement instruments.

As patients' length of stay measures the health care service quality, it can be inferred that various internal and external factors determine the LOS in the emergency departments. (Bashkin et al., 2015) identified some of the factors that are responsible for the prolonged stay of inpatients. The causes of these delays include management, examination procedures, emergency environments, resources, and patient flow. The observation units were developed to manage these challenges, and the departmental services were analyzed. The past studies shed light on the organizational factors that impact the length of stay of inpatients. The researchers mentioned multiple reasons to evaluate the management and short–term facilities at the patient's arrival that can impact their LOS. From their viewpoint, the absence of medical specialists, consultation, and laboratory delays significantly impact LOS(Driesen et al., 2018). As the length of stay quantifies the primary services and hours given to the patients, the observations brought out multiple diagnostic activities related to patient-related factors that can improve or enhance the LOS of inpatients. Patients' input and output processes are measured by LOS, which indicates that the quality and performance of emergency departments are often affected by long LOS (Chaou et al., 2017). The study examined the observation period stay of patients and evaluated the factors that cause delay. Through performance indicators, strategic measures were proposed to improve ED performance and quality. Emergency service observation stay is followed by 2 different data sources: the hospital and the Ministry of Health business intelligence parameters.

The role of the clinical decision support system in evaluating the healthcare providers and services was observed. Past medical studies showed that the CDSS provides leverage in managing and evaluating patient-related data (Park et al., 2022; Wu et al., 2020). It is observed that CDSS is positively associated with patient safety and treatment quality. Employing this system can also improve medical errors and delayed diagnosis processes (Zhou et al., 2021). Therefore, the clinical insertion of a support system can improve medical diagnosis, services, and costs (Belard et al., 2017).

Moreover, the impact of CDSS on medical practitioner performance and patient outcomes can be analyzed by the professional preferences of the physicians (Liberati et al., 2017; Zikos & DeLellis, 2018). Using patient monitoring devices and electronic medical record systems reduces medical costs and improves inpatients' observatory period (Mebrahtu et al., 2021). In case of sports injury emergencies i.e. tissues and bone surgeries, the CDSS along with digital and technical solutions can provide better medical solutions.

Tracking units and their operations

Within the Quality Standards and Health Accreditation Standards, indicators are followed by the hospital quality management unit.

For each indicator by the quality unit, Cards containing information such as the purpose of the indicator, data collection method, calculation method, target value, and responsible persons were created. The quality management unit coordinates indicator management. Data collection and data analysis is done from HIS. The quality unit consists of people who have received training

in quality and accreditation systems and have a command of the health system (KAPLAN & DEMİR).

Through those indicators, the quality standards and management services were observed. The quality management unit compares the target value determined on the indicator card with the value on the analysis screen. In case of deviation from the target value, corrective and preventive action is initiated. Since the waiting period for observation was within the knowledge of the hospital performance and ministry, the prolongation of the observation period was evaluated together with the management, and improvement studies were carried out (DOĞAN, 2021).

The relevant chief physician and assistant chief physician controlled the admin follow-up screen. Instant and retrospective data were taken and evaluated simultaneously and instantaneously by the efficiency evaluation criteria (productivity and quality application department). All hospitals were visited once a year by the efficiency department evaluators, and the efficiency score was calculated.

An informative SMS was sent to the Deputy Chief Physician regarding the patient-based efficiency evaluation criteria (efficiency and quality application unit) and the patient observation waiting period determined by the Ministry of Health, which is a maximum of 8 hours. The main concern was that the ideal observatory time as the patient applying to the clinic should not exceed the 4 hours determined by the ministry as per the circular (KAPLAN & DEMİR)

The ideal value, which is 4 hours, varies according to the hospital structure. For example, in our hospital 2 years ago, this average value was below 3 hours, but in the last two years, the average value is increased to 4 hours.

During that time, the relevant chief physician and the Quality and Efficiency Unit started corrective and preventive work with the senior management and quality unit in line with the emergency service indicator follow-ups. Our hospital has a fully digital structure with a HIMSS-EMRAM level 7 certificate, which has been digital scoring since 2016. Due to this system, which originates from the United States of America, all medical procedures are designed in HIS.

Hospital performance and business intelligence were seen in the overall workflow chart. Different analyzes are controlled by different criteria and followed by different action paths. The observation standby data taken from two sources are given below.

a)   Quality and efficiency standards are used as the indicator set.

Data sources can be reported monthly from the quality indicator cards screen in the hospital information system, and monthly from the analysis report "average observation times in the emergency department" in the emergency department screen's emergency management tab. The result is

automatically displayed on the indicator cards by proportioning the total observation time in the relevant period to the total number of hospitalized patients. This screen is monitored by the hospital quality unit and recorded on the screen monthly and quarterly.

b) It is evaluated by productivity monitoring and verification officers in line with the efficiency criteria determined by the productivity and quality implementation department. It is displayed as monthly, instantaneous average minutes on "AS.9.3. Average Length of Stay in the Observation Room" on HBS. These data are monitored by the deputy chief physician of the emergency department and the chief physician. Simultaneously, as in all hospitals, the efficiency and quality implementation department evaluates the data on a hospital basis. In addition, the hospital is evaluated annually by efficiency teams (efficiency criteria)

In order to evaluate the accuracy of the data, the data collection form for the duration of stay indicator is used on the indicator reports screen.

MATERIAL AND METHODS

In all hospitals, this situation is followed as an emergency service indicator and checked regularly. The results are sent to the Ministry of Health Institutional Quality System (KKS) at 3-month intervals as data.

The average target value for hospital emergency services and inpatient treatment in the selected hospital is 240 minutes, determined as 210 min in January, 144 min in February, 193 min in March 193, and 475 min in April 2020.

Due to the varying length of emergency stays in those hospitals, the hospital data for the same period (number of hospital beds, number of emergency services, same group according to the Ministry of Health, similar population) was compared.

The difference and source of the disruption in the emergency department from other hospitals that needed revision were investigated. Due to the value above this target value, corrective and preventive action has been initiated in the quality unit. In this context, to examine the LOS of physically injured patients, the following emergency services were examined:

• Patient management (incoming patient diagnoses)
• Emergency bed management
• Patient approach, treatment, and diagnosis (laboratory, radiology, etc.)
• Applicable in the areas of auxiliary personnel distribution
 In order to evaluate all these indicators of LOS, Root cause analysis was performed.

In Figure 1, emergency service waiting times of similar hospitals were compared with their institutional data. While the average value was 193 minutes in March 2020, this time increased to 475 minutes in April.
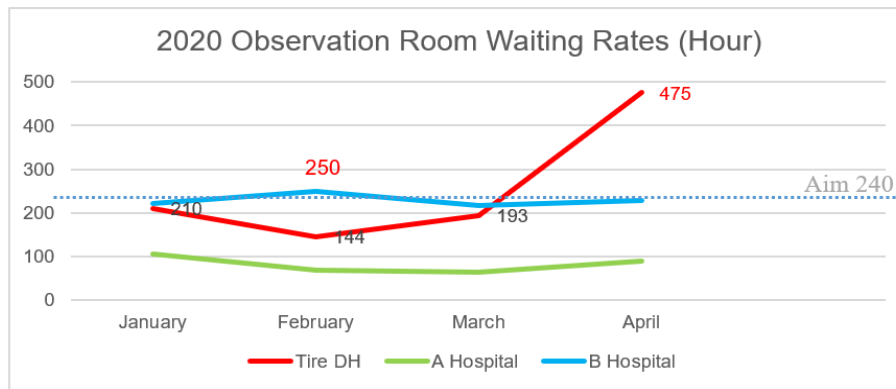
Figure 1. Comparison of similar hospital data

The source of the problem was investigated. Corrective and preventive action has been initiated in the quality unit as an observed value was more than the target value; the following emergency services were proposed:

1. Patient management (incoming patient diagnoses)
2. Nature of injuries and percentage of inpatients
3. Emergency bed management
4. Patient approach, treatment, and diagnosis (laboratory, radiology, etc.)
5. On the issues of auxiliary staff distribution
6. Root cause analysis was performed. The problem was identified, and the following was examined, summarized, and presented to hospital management.

As a result of the deterioration of the monitored indicator data and the corrective and preventive action of the hospital quality unit, studies have been started to create digital solutions within the HIS in the hospital management emergency department.

In the first step, "Patient Status" variations were examined in the case of patients who exceeded 2 hours in emergency observation in the first 4 months period indicated in the graph (Figure 2).
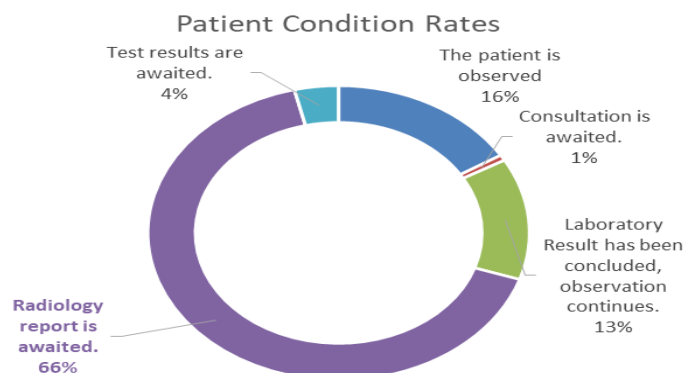

Figure 2. The proportions of the reasons for prolonging the observation waiting time were analyzed.

The five chief reasons were observed, which resulted in a prolonged observation period. As per the results, 66% of the reason for waiting is the

radiology report process, 16% of the patients are kept under observation, 13% of the laboratory results are out, but the observation continues, and 4% are waiting for the results of the examination. The emergency procedure for physical sports injuries includes advanced physical examinations and their results. On such a basis, the observation waiting time was prolonged due to the delay in lab reports and results. The prolongation due to laboratory reports and examinations, i.e., delay in the radiology report, CT and MR, were compared to the previous year.

The analysis was done by comparing the recorded percentages of both years. When the April 2019-2020 MR and CT numbers are compared, the number of CTs increased by 96.24% compared to the previous year, the number of MR increased by 26.92%, and the CT scans of 2019 and 2020 are approximately 2 times more scanned when compared numerically (shown in Figure 3).
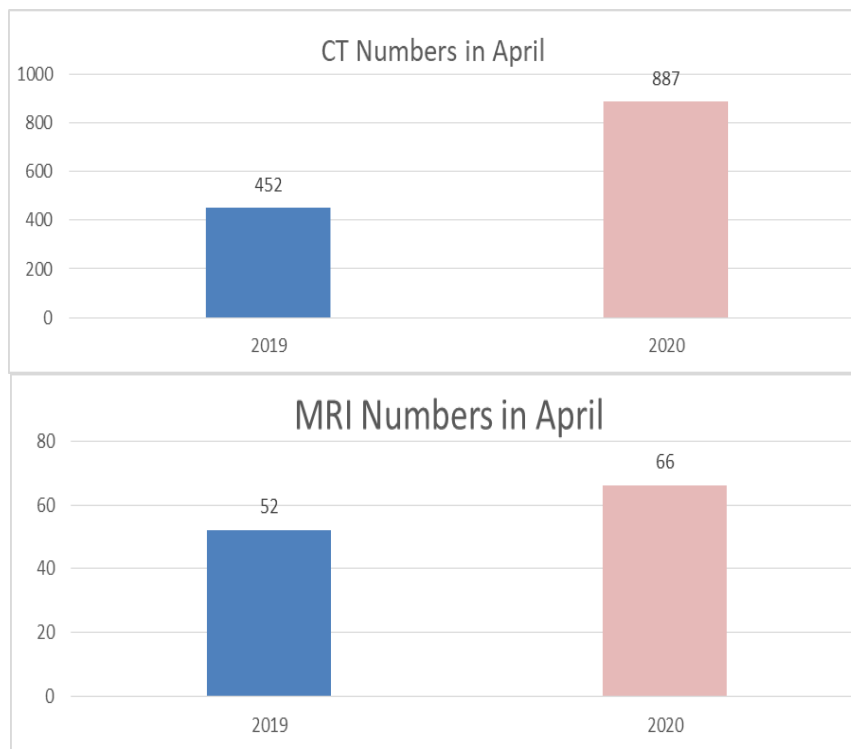

Figure 3. Comparison of MR and CT numbers in April 2019-2020.

In the second stage, patients who needed CT were grouped according to their ICD-10 diagnosis, and the first 5 diagnoses were determined. The first 5 diagnoses are those related to severe physical injury, i.e., fractures, and tissue injuries, which increased by 68%.

DÖF (preventive regulatory form), request information was discussed with HIS company, and joint decisions were made. Digital measures were planned so the physician could follow the patient's process. Reminder SMS and Clinical Decision Support systems (CDSS) alarms were created in HBS. In order to increase patient circulation for short-term inpatients in the Emergency Service observation area and to ensure that the Ministry of Health rule does not exceed 4 hours, warning systems have been designed for the

physician to follow the patient process.

1. The patient's physician was informed that "…the patient was followed up in the emergency room for 2 hours" (SMS) and was informed via SMS every 30 minutes.
2. Monitoring "3 hours have passed" screen warning and redirection to the monitoring screen (POP-UP)
a. 30 min screen warning repeat
Patient warning to the Emergency Service physician whose observation time exceeds 3 hours and control question screen to the patient list.
b. Reason for extension of hospital stay for each repeated stimulus (submitted to physician's choice)

   c. Simultaneously, an SMS alert was created to the radiology doctor for the title of "radiology report result" (66% frequency), which has the highest selection rate in the patient status field on the currently available emergency observation screen.

   3. Emergency Service Clinical Decision Support System in HIS was created especially for young and child patients with acute and chronic injuries, which increases the waiting time in the emergency department in our hospital. When the physician enters the relevant ICD-10 diagnosis, and the tests created with a template are automatically sent, an alert is created to the physician by consulting the radiology specialist and supporting them with SMS. A comprehensive framework was proposed to map the initial diagnosis and the individualized inpatient care. The framework comprised the areas where and to whom CDSS can benefit physical rehabilitation and surgical centers. It assists in evaluating the areas where CDSS can be employed for the greater good. Even though the absence of the original CDSS system caused inconvenience, it was ensured that the pre and post CDSS regulations and operations were also measured. The CDSS functionalities and assistance to different medical actors are shown in Figure. 4

Table 1. CDSS assistance

Actors	CDSS Assistance
Patients, Receptionist	Capture information from patient's survey
Research Staff	Make diagnosis and treatment reviews.
Research Staff	Notifications of upcoming appointments
Surgeon	View medical history details

ANALYSIS AND OUTPUTS

One of the important indicators of a long hospital stay was bed management and tracking. The turnover rate of hospital inpatient and emergency service beds is the parameter that shows the effective use of beds. It can also be defined as the number of patients per day per bed. Therefore, good service qualities include bed allocations and their transfer to ensure real-time operational services. At first, the type of injuries and their impact on the emergency stay was analyzed. The admitted patients were categorized under the nature of their injuries and their treatment procedure

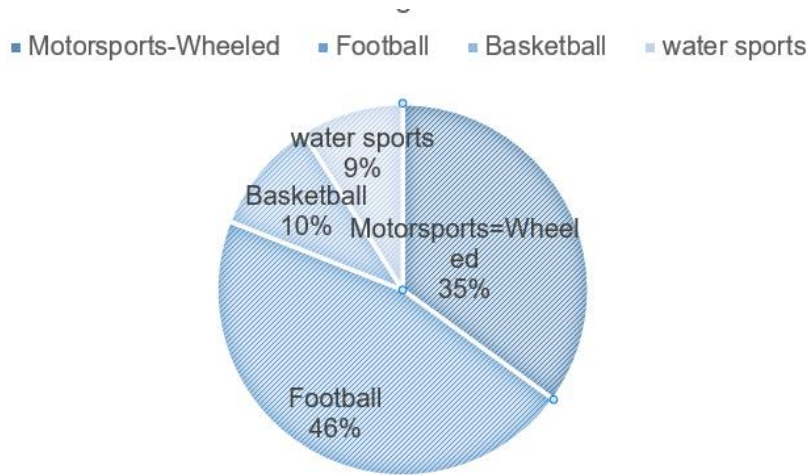■ Motorsports-Wheeled   ■ Football   ■ Basketball   ■ water sports

Figure 4. Emergency department attendees from a sports injury

The diagnosis observed that the higher injuries were ligament and head injuries. The motorsports results in 80% severe head and neck injuries. Football results in more than 70% of lower limbs injury. While on the other hand, the rest of the sports injuries need minor surgical procedures. The patients diagnosed with head, limb, and head injuries were subjected to prolonged emergency stays. The long LOS is followed by emergency services management, i.e., bed allotment and delayed lab results, which were analyzed in the further procedure

The increase in the number of patients admitted to the emergency department in March, April, and May 2020 and 2021 compared to the total number of patients admitted to the emergency department was analyzed.

Table 2. The number of patients admitted to the emergency department in March, April, May 2020, and 2021.

2020	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Length of Stay (Minute)	210	144	193	475	384	162	172	238	240	205	192	146
Average Stay (Hour)	3,5	2,4	3,2	7,9	6,4	2,7	2,9	4,0	4,0	3,4	3,2	2,4
Aim							4					
First 5 Monthly Average										4,7		

2021	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Length of Stay (Minute)	215	147	181	140	115	144						
Average Stay (Hour)	3,6	2,4	3,0	2,3	1,9	2,4						
Aim						4						
First 5 Monthly Average						2,6						

Time to take action →

Observation Waiting Rates for the First 5 Months of 2020-2021 (Minute)
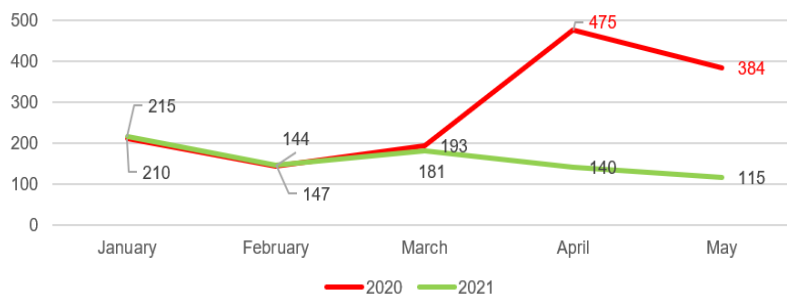
Figure 5. 2020-2021 first 5 months waiting times comparison.

Table 3. RATIO of patients under observation. (Patient Observed / Total Number of Patients = RATIO)

Year	March	April	May
2020	6243/7209=0.86	3207/3613=0.88	4417/5013=0.88
2021	8223/8744=0.94	9621/10120=0.95	8246/9139=0.91

An increase was observed when the number of patients admitted to the emergency service in March, April, and May 2020 and 2021 were compared with the total number of patients admitted to the emergency department (Table 3). The increased number of patients is directly associated with the observatory time of patients and indirectly with the emergency unit operational rate, i.e., the number of their staff, quickness, and service availability.

Based on the patients admitted, the bed rotation rate was examined. The bed transfer rate was calculated daily during the pandemic process.

Bed Turn Rate = Number of Inpatients / Number of Patient Beds

The bed transfer rate was calculated daily, and the results are given in Figure 6 and listed in Table 4. We can also describe it as the number of patients per day per bed.

Table 4. Bed transfer rate (number of patients per day per bed).

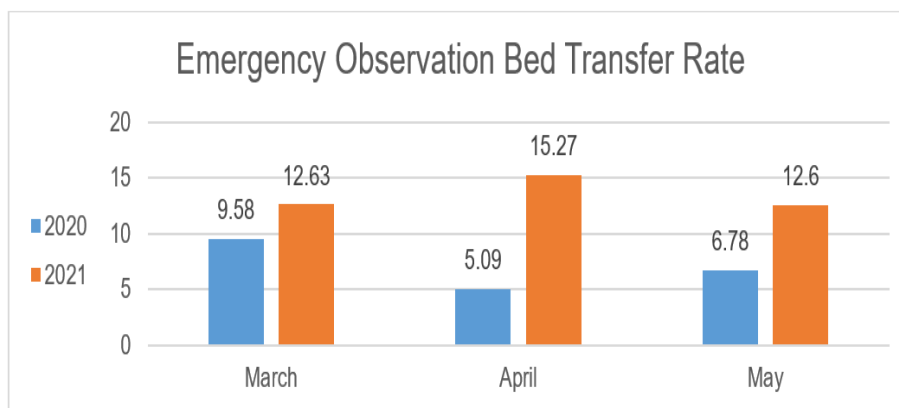| Year	March	April	May	Average
2020	9.58	5.09	6.78	+%8
2021	12.63	15.27	12.6	

Figure 6. 2020-2021 bed turnover rate comparison

Although the number of patients with increased waiting time in the emergency department and the number of emergency beds are the same, the 88% increase in the bed turnover rate indicates the effective use of emergency beds.

DISCUSSION AND CONCLUSION

With the increased number of sports injuries over the last few years, concern has arisen about addressing the factors impacting the patient's outcomes and their initial medical procedure (Peterson & Renstrom, 2019; Roy-Davis et al., 2017). Despite lower mortality risks, physical sports injuries are the major reason for long-term physical health complications and

disabilities (Molloy et al., 2020; Smith & Sparkes, 2019). These issues, therefore, draw our attention toward the hospital-related factors that significantly impact the patient's treatment procedure and stay at observation period. The study examined the organizational and institutional factors that play a major part in determining the length of stay of inpatients that came to physical injuries emergency mainly out of sports. The duration of stay at the hospital was measured to navigate the main cause. The duration of hospitalization, which was followed through 2 channels during the period 2020-2021, was analyzed. The chief reason was the prolonged duration of inpatients stay at hospital , as the ministry determined that they had exceeded it. The applications used were made using the full digital structure and their results were evaluated between 2020 and 2021. The period was significant as the hospitals were overburdened because of severe health issues amid the pandemic. The physical injury departments also faced severe challenges regarding patient management and treatment. The parameter showing the effectiveness of the emergency department is the duration of the yellow zone (inpatient treatment) in triage. 2 different methods measure these times. According to the hospital quality and accreditation unit quality standards, the average data are calculated monthly and sent to the quality unit of the Ministry of Health. The other source of data calculation is the data that can be accessed instantly and retrospectively from the productivity portal of the institution affiliated with the Ministry of Health, which hospital managers use (Batista et al., 2020; Karamik & Seker, 2015).

The selected hospital has had a fully digital structure with a HIMSS-EMRAM level 7 certificate since 2016. The fully digital structure allows unit and department-based applications to facilitate and accelerate the service provided to all providers. Nurse and Physician clinical decision support systems warnings are available in the inpatient services of the hospital's intensive care units. CDSS and HBS were also applied to shorten the duration of stay in the emergency room and to increase the bed turnover rate(AYDEMİR, 2019).

The mean target value for inpatient treatment in hospital emergency services and in our hospital is 240 minutes. It was determined as 210 min in January, 144 min in February, 193 min in March 193, and 475 min in April 2020. Due to the increase at the beginning of the 2020 2nd term (April), it was also found to be high when compared to similar hospital data.

Sports injuries usually have low-risk factors, but ineffective measures and immediate treatments can lead to long-term disability and physical defects. The prolonged stay of patients in emergency units has a notable impact on the rest; therefore, the issue draws our attention to the effective emergency management services that impact the patient's duration of stay—the medical treatment for sports injuries. Later, diagnosed injuries were categorized based on inpatients in the emergency department. According to the results, the severe brain and limb injuries resulting from sports activities resulted in prolonged duration of those patients in emergency units. Within the observatory period, they have also produced the reasons for a prolonged hospital stay. When the reasons for waiting in the emergency room yellow

area of our hospital were examined, it was determined that the most common reason for waiting was the waiting time for the radiology report at a rate of 66%. Therefore, a more detailed analysis was performed. Patients who needed CT for analysis were grouped according to their ICD-10 diagnoses, and the first 5 diagnoses were determined. ICD-10 diagnoses, which caused a 68 percent increase in the examination, were identified as severely injured diagnoses. A "technological" solution to the problem was developed, and a decision support system was created in the emergency department of the hospital information system. Digital measures were implemented to inform the physician and emergency room manager early. The average observation times for the first 5 months of 2020 and 2021 are compared. The average observation time for the 5 months of 2020 was 4.7 hours, while the average observation time for 2021 was 2.6 hours. The first of the important parameters in the measurement of effectiveness in the emergency department is the patient's length of stay. Accordingly, the bed turnover (effectiveness) has improved measurably with digital measures(Oakes, 2021).

After observing the length of stay, some of the most important performance indicators were used in evaluating hospital services. One of the indicators is to show how effectively hospital beds are used. For this purpose, the average day of hospitalization, which is the bed use activities of a public hospital, rate, bed occupancy rate, bed turnover rate, and bed turnover interval was analyzed by the Ministry of Health in our study. The relative comparison with the average was evaluated. Different criteria from various sources have defined the effective use of hospital beds (AYDEMİR, 2019; Bagust et al., 1999; Feibert & Jacobsen, 2019).

Although the number of patients with increased waiting time in the emergency service and the number of emergency beds are the same, the 88% increase in bed turnover has shown the effective use of emergency beds.

It has become important to act faster and together in physically injured emergencies and mass disease groups (not only in pandemics but also in cases of mass poisonings, major traffic accidents, etc.) that increase the hospital emergency room burden. For this reason, early warning systems should be designed as simultaneous SMS to the manager, to the treatment services manager for bed management, to the physician in charge of the emergency service, to HBS as the warning CDSS, and the response should be accelerated with instant notification. In this way, all responsible persons are informed simultaneously, and delays are prevented (Li et al., 2021; Sreejith et al., 2020). Clinical Decision support systems are also used in physicians and nursing practice in the Izmire Tire State Hospital emergency department services.

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