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SIGMA LEVELS ANALYSIS OF INTERNATIONAL PATIENT SAFETY GOALS FOR A PRIVATE HOSPITAL*

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ABSTRACT

In this study, sigma levels of International Patient Safety Goals (IPSG) of a private hospital accredited by JCI were analyzed. The data related to the processes were obtained from the security reporting notices of the hospital for 2011-2018. The error numbers obtained from the security reporting reports and the error numbers per million were found using the Defects Per Million Opportunities (DPMO) formula and sigma levels were obtained by using sigma conversion table.

As results of analysis, although the increases and decreases observed in the years, IPSG' sigma levels have taken 4.2 and above values it's over the acceptable range 3-4 sigma for health institutions in Turkey. Also the sigma level of the infection prevention process was found to be lower than the others while the sigma level of the process of ensuring effective communication was the highest. The sigma levels calculated for the goals support that IPSG processes are well managed in this hospital. As a result it can be said that this hospital managed well process of IPSG.

Key Words: Patient Safety, Six Sigma, International Patient Safety Goals, Sigma Level analysis

A R T I C L E I N F O

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1. INTRODUCTION

The basic principle of health services is patient safety. The fact that the most basic element of the patient care process is the patient requires responsibility awareness, current knowledge and attention to be valid throughout the whole process. Various problems that occur in the process or system in patient-oriented treatment practices may reveal situations that may harm the patient. Patient safety; It is a complex system that includes performance improvement, environmental safety and risk management as well as service improvements, infection control, safe use of medicines, equipment safety, safe clinical practices and safe care environment (Aştı ve Acaroğlu, 2000: 22).

Some institutions that are aware of the importance of patient safety have made patient safety a standard. One of them is Joint Commission International (JCI). There are 6 International Patient Safety goals in the context of JCI standards. These are can be sorted as (Joint Commission International, 5th Ed. 2014);

1. Accurate identification of the patient
2. Enhancing Effective Communication
3. Improving the Safety of High Risk Drugs
4. Ensuring Right-Side, Right-Procedure and Right-Patient Surgery
5. Reducing Health Care Related Infections
6. Reducing the Risk of Damage to Patients from Falls

Each of the International Patient Safety goals is important for patients. An error in any of these goals may cause unwanted results. For each goal, process definitions should be made and standardization should be ensured. To adopt a culture of improvement and safety in patient safety; It is primarily based on the adoption by the employees of the organization into a corporate culture and the implementation of system improvements with a systematic and planned approach. Since the Six Sigma approach has a "zero defect" focus in practice, it is thought that it will be increasingly preferred for quality improvement. (This sentence has not been cited from a resource).

Six Sigma is a quality approach that aims to reduce the error in processes to zero. A business with a Six Sigma level has a maximum error of 3.4 per million. Six Sigma which aims to reduce the variation in processes, is a measurement technique that shows how much businesses have detected from zero error locations. Six Sigma, which measures and analyzes the processes, although it first appeared in a company serving in the manufacturing sector due to the fact that concrete outputs are easier to measure, it has started to gain importance in the service sector and health sector influenced by changing and diversifying socio-economic factors (Deniz et al, 2016).

The importance of six sigma and patient safety has attracted the attention of researchers. (Sehwail and DeYong, 2003; Revere, et al., 2004; Antony et al., 2007; Feng, 2008; Souza, 2009; Gowen, 2012; Chiarini, 2012; Andrea, 2013; Jiju et al., 2013; Alessandro et al. 2013; Bhat vd., 2014; Nilson and Sandoff 2015; Gijo et al., 2016). Academic studies have been done on Six Sigma in Turkey, began to concentrate in the early 2000s. It is seen that these studies are mostly related to the theoretical structure of Six Sigma philosophy and principles, factors affecting Six Sigma success, Six Sigma applications and successes or Six Sigma's statistical and data processing dimension. Although these studies are oriented towards the production sector, it is seen that few studies related to the service sector have been included in

the literature in recent years. (Dağlıoğlu 2009; Öztop, 2010, Akyalçın, 2010; Dinçel, 2011; Emekli, 2012; Cebe, 2013; Deniz, 2015). Similarly, studies on patient safety in Turkey is not sufficient in number (Aştı ve Acaroğlu, 2000; Aslan ve Ünal, 2005; Candaş ve Gürsoy, 2015; Korkmazer et al., 2016; Yurttaş vd., 2016; Bişkin ve Cebeci, 2017; Karayurt et al., 2017; Mesken, 2018; İskenderoğlu et al., 2018). The absence of a study combining Six Sigma and International Patient Safety in the domestic and foreign literature is the starting point of this study.

The aim of this study is to reveal the sigma level of International Patient Safety Goals in a private hospital that adopts patient safety as a culture in its own institution, routinely provides training to its employees on patient safety and tries to produce solutions by focusing on the system in case of any error. The sigma levels were analyzed through the data obtained from the security reporting notification system of the hospital and the errors that occurred in the processes.

APPLICATION: Determination of Sigma Levels for International Patient Safety Goals

This study was carried out in a private hospital accredited by JCI to determine sigma levels for International Patient Safety Goals. This hospital has 103 beds and 400 employees. In addition, the importance given to lean practices in the hospital has been the reason for preference of this hospital in the study. The data related to the processes were obtained from the safety reporting notifications of the hospital for 2011-2018. The number of errors received from the security reporting notices and the number of errors per million were calculated using the DPMO formula. Then sigma conversion table was used to obtain sigma levels corresponding to DPMO.

Calculation of Sigma Levels for Ipsg

To calculate the sigma level, the number of errors per million in the process is first calculated using the errors in the processes, the total number of operations, and the events that generate the errors (probability of failure). DPMO formula was used to determine sigma levels of IPSG. The table of sigma levels is then used to find the sigma level corresponding to the DPMO values obtained (Işığıçok, 2011: 7).

$$\text{DPMO}=\left(\frac{D}{N*O}\right)*1.000.000$$

N: Total number of products

D: Total Number of Defective Products

O: Total Number of Error Types

DPMO: Error Probability in Millions

DPMO formula used for each goal to determine sigma levels of IPSG are summarized in Table 1.

Table 1: Formulas Used in Sigma Levels Analysis

Goals	DPMO
Verification of patient identity	Reported incorrect authentication counts /Total number of application in a year x1.000.000 Number of error type (1)
Ensuring effective communication	Number of communication errors reported/Total number of application in a yearx1.000.000 Number of error type (3)
Ensuring safety of high risk drug	Number of drug errors reported / total number of hospitalizations in a year x1.000.000 Number of error type (5)
Ensuring safe surgery	Number of reported surgical errors / total number of operations in one year x1.000.000 Number of error type (4)
Prevention of infections	Number of patients with infection // total number of hospitalizations in a year x1.000.000 Number of error type (3)
Prevention of falls	Number of patients falling reported/ total number of hospitalizations in a year x1.000.000 Number of error type (2)

2. FINDINGS

DPMO and sigma levels for each of IPSG processes using the formulas in Table 1 for 2011-2018 are shown in Table 2. According to Table 2 sigma levels of IPSG are higher due to literature. Considering that 2-3 sigma levels are acceptable in the literature, the International Patient Safety Goals sigma level is the smallest value of 4.2 over the years and is higher.

Table 2: DPMO of IPSG and Sigma Levels

IPSG	Years	DPMO	Sigma Level
Verification of patient identity	2011	-	-
	2012	7.13	5.8
	2013	25.98	5.5
	2014	41.00	5.4
	2015	65.29	5.3
	2016	78.59	5.2
	2017	59.61	5.3
	2018	29.86	5.5
Ensuring effective communication	2011	71.53	5.3
	2012	-	-
	2013	4.06	5.9
	2014	-	-
	2015	-	-
	2016	78.30	5.2
	2017	25.73	5.5
	2018	-	-
Safety of High Risk Drugs	2011	-	-
	2012	-	-
	2013	414.28	4.8
	2014	230.81	5
	2015	3036.0	4.2
	2016	3242.7	4.2
	2017	61.76	5.3
	2018	28.44	5.5
Ensuring The Right Field. The Right Procedure. The Right Patient Surgery	2011	111.70	5.1
	2012	40.84	5.4
	2013	-	-
	2014	61.41	5.3
	2015	25.70	5.5
	2016	167.65	5
	2017	90.20	5.2
	2018	42.44	5.4
Reducing Risks caused by infection	2011	-	-
	2012	2101.49	4.3
	2013	1340.31	4.5
	2014	769.37	4.6
	2015	805.01	4.6
	2016	1827.05	4.4
	2017	1338.27	4.5
	2018	758.43	4.6
Prevention of falls	2011	321.88	4.9
	2012	134.13	5.1
	2013	365.54	4.8
	2014	346.22	4.85
	2015	215.62	5
	2016	156.60	5.1
	2017	154.41	5.1
	2018	193.82	5

Examining the sigma levels in Table 2 for each goal separately:

- *Verification of patient identity*: Although its sigma level has not shown a steady increasing trend over the years it is quite high. Based on these findings, it is observed how the processes of patient identity verification perform in practice. The compliance rate of this indicator followed up since 2016, is 98.90% for 2016; 98.45% for 2017 and 98.21% for 2018.
- Effective communication: It is seen that the processes related to this target have sigma levels above 5 and there is no standardization in the trend of sigma values of process. The compliance rate of this indicator followed up since 2016, is 98.94% for 2016; 95.45% for 2017 and 96.80% for 2018.
- Ensuring drug safety: The sigma level of this goal is higher than the literature (4.2 sigma and above), but there is no linear increase in the tendency of the processes over the years. In 2011 and 2012, no safety reporting records related to drug safety were found. However, when the error records and theirs values made in the following years are taken into consideration, it is concluded that there were not any errors in the processes in 2011 and 2012, but not notification. The compliance rate of this indicator followed up since 2013, is 95,68% for 2013; 95.23% for 2014, 98,31% for 2015, 97.97% for 2016, 99.54% for 2017 and 100% for 2018.
- Ensuring The Right Field, The Right Procedure, The Right Patient Surgery: The sigma level for this process was higher than the literature (min. 5 sigma), but there was no linear increase in the tendency of the processes over the years. In 2013, no safety reporting was made within the scope of safe surgery, and the reports made in other years were near-event reports, and it was detected that the situation was corrected without any permanent damage to the patient. According to the indicator data that has been followed since 2011, it is determined that a safe surgical checklist is used for each patient who underwent surgery. Patient files are prepared by the hospital unit when the patient comes to hospitalization thus avoiding the overlook of document being included in the file.
- Prevention of infections: Hospital infection rate was started to be monitored since 2012. In the process of prevention of infections; In general, there is an increase in sigma levels over the years. Three of the indicators are directly related to the prevention of infections followed by the quality unit in the hospital every month. These; hospital infection rate, hand hygiene compliance rate and correct use of surgical prophylaxis. The hospital infection rate for the years 2011-2018 respectively was 0.64; 0.48; 0.23; 0.18; 0.59; 0.43; 0.28 and these values were parallel to the sigma level. The rate of hand hygiene compliance, which was started to be monitored in 2016 was 71.55, 68 in 2017, 70.67 in 2018. Considering that the hand hygiene compliance rate in the literature is around 60%, it is seen that the hand hygiene compliance of the hospital is above the literature average.
- Prevention of falls: It has been observed that the sigma levels of the processes related to reducing the risk of injury due to falls ranged from 4.8 sigma levels to 5 sigma levels over the years. The compliance rate of this indicator followed up since 2016 is 99.08% for 2016, 98.22% for 2017 and 98.12% for 2018.

3. CONCLUSION

In this study, sigma levels of International Patient Safety Goals (IPSG) of a private hospital accredited by JCI were analyzed. Data related to the processes were obtained from the safety reporting notifications of the hospital for 2011-2018. The number of errors received from the security reporting notices and the number of errors per million were calculated using the DPMO formula. Then, sigma conversion table was used to obtain sigma levels corresponding to DPMO.

As a result of the analysis, although sigma levels decreased / increased compared to years, values were 4.2 and above and these values are above of the acceptable range (3-4 sigma) for healthcare institutions in Turkey. The minimum sigma level of 4.2 indicates that there are very few errors in the process. It can also be said that the staff are careful not to make mistakes in the related processes.

When sigma levels of International Patient Safety Goals are evaluated; sigma level of infection prevention process is lower than others. Infection control should be the responsibility of everyone working in the institution. Within the scope of the in-service training program, training should be planned for each field regardless of occupational groups. The process with the highest sigma level is the process of ensuring effective communication. Sigma levels confirm that the hospital manages the IPSG processes well and adopts it as an institutional culture. Despite the awareness in the organization and all the processes written down and made available to the employees, it was observed that although the errors might occur in the processes, the sigma level of the organization was high.

Today, institutions make use of data in decision making and policy making. Thus, the previous month/year/period and so on period, they follow the development curves. However, as the institution does not have the same denominator as the previous period, the results do not fully reflect the current situation. If the institution expresses the current status indicators by sigma level, it will be easier and more understandable to follow the development curve of the processes between periods. With the determination of sigma levels of processes, institutions will make more efforts to achieve excellence (6 sigma) and they will also have the opportunity to improve by seeing where the staff is missing.

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