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Metrics of efficient use of operating rooms during the SARS-CoV-2 (COVID-19) pandemic

Métrica de indicadores de uso eficiente de quirófano durante la pandemia por SARS-CoV-2 (COVID-19)

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ABSTRACT. Introduction: the COVID-19 pandemic has induced a transformation in the way hospitals function, causing a decrease in the time and efforts dedicated to surgical activity, which in turn has caused delays in the surgery schedule of most hospitals. This represents a major public health problem, significantly compromising the principle of equity that inspires public health systems throughout the world. To address this problem, it would be of the utmost importance to put in place initiatives to measure and improve surgical efficiency. **Objective:** evaluate indicators of efficiency in the use of operating rooms during the COVID-19 pandemic. **Material and methods:** a descriptive, longitudinal retrospective study was conducted on 3554 patients scheduled for surgery during a one-year period of the COVID-19 pandemic. Indicators of efficiency in they use of operating rooms were measured. The data was processed using SPSS v-25.0. **Results:** a total of 3,554 surgeries were scheduled, 1,309 of them emergency surgeries, 1,979 elective surgeries, and 266 deferred surgeries. The following parameters were estimated: Starting time of the procedure (42.32 ± 37.04 min); opportunity for emergency surgeries (104.69 ± 102.55 min); starting time of anesthesia (10.11 ± 9.85 min); starting time of surgery (40.03 ± 24.68 min); time of admission to post-anesthesia care unit/intensive care unit (PACU/ICU) (15.35 ± 29.94 min); turnover or replacement time (177.97 ± 174.33 min); active surgery time (27.70%). **Conclusions:** the COVID-19 pandemic negatively impacted the indicators of efficient use of operating rooms, posing new challenges for the management and organization of surgical work.

RESUMEN. Introducción: *la pandemia por COVID-19 ha emplazado una transformación hospitalaria, esto acarreó un decremento de la actividad quirúrgica e implicó un aplazamiento en la programación, lo que representó un problema, ya que comprometió sensiblemente el principio de equidad que inspira a los sistemas sanitarios. Así, resultó imperativa la implementación de iniciativas para medir y mejorar la eficiencia quirúrgica.* ***Objetivo:*** *medir los indicadores de uso eficiente del quirófano durante la pandemia por COVID-19.* ***Material y métodos:*** *se realizó un análisis descriptivo, longitudinal y retrospectivo en 3,554 pacientes programados para cirugía, durante la pandemia en un período de un año, además se midieron los indicadores de uso eficiente del quirófano. Los datos fueron procesados en SPSS v-25.0.* ***Resultados:*** *se programaron 3,554 cirugías, 1,309 urgencias, 1,979 electivas, 266 diferidas. Se estimó un tiempo de inicio del procedimiento 42.32 ± 37.04 min, oportunidad para urgencias quirúrgicas 104.69 ± 102.55 min, tiempo de inicio de anestesia 10.11 ± 9.85 min, tiempo de inicio de cirugía 40.03 ± 24.68 min, tiempo para la admisión en la unidad de cuidados postanestésicos/unidad de terapia intensiva (UCPA/UTI) 15.35 ± 29.94 min, tiempo de rotación o recambio 177.97 ± 174.33 min y tiempo quirúrgico activo 27.70%.* ***Conclusiones:*** *la pandemia por COVID-19 impactó negativamente en los indicadores de uso eficiente del quirófano, lo que implicará nuevos retos en la gestión y organización de la jornada quirúrgica para su mejora.*

Keywords: operating room, indicators, efficiency, health management, Mexico.

Palabras clave: *quirófano, indicadores, eficiencia, gestión sanitaria, México.*

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INTRODUCTION

November 17, 2019, was the date of the first case of infection by SARS-CoV-2 (COVID-19). Patient zero was a 55-year-old male living in Hubei province, but it was not until December 27 that Zhang Jixian, a doctor at the local Provincial Hospital for Integrated Chinese and Western Medicine, warned health authorities about the new disease. On January 7, 2020, at the Chinese Center for Disease Control and Prevention (CCDC), the causative agent of this pneumonia of unknown etiology was identified as a coronavirus associated with acute respiratory syndrome. It was named SARS-CoV-2 due to its similarity to the SARS-CoV, which was discovered in 2003[1,2].

In Mexico, the first case of COVID-19 was detected on February 27, 2020. The number of cases increased rapidly throughout the world, following an exponential growth pattern that led the World Health Organization (WHO) to declare a pandemic on March 11, 2020[3,4].

During the following year, the spread of the infection and the intensive use of resources to fight it led to changes in health systems throughout the world[5,6].

In the attempt to provide health services to the greatest number of patients infected by SARS-CoV-2, hospital institutions adapted by changing their logistical infrastructure, which led to a reduction or temporary suspension of surgical activity[7,8].

As a result, the number of patients awaiting a surgical procedure has tended to increase in a context of an economic and health crisis that limits the ability of hospital institutions to provide the services usually demanded from them[7].

Different strategies have been used to try to address this mismatch between supply and demand of health services, all of them without success. We consider that their failure was due to inadequate management, lack of inclusion criteria based on scientific evidence and lack of efficiency criteria for the use of resources. During a pandemic such as this, it is of utmost importance to implement initiatives to measure and improve the efficiency of surgical activities.

In economics, efficiency is conceived as the relationship between the results obtained and the resources used; it is the ability to achieve a desired effect with the least possible resources. The operating room is one of the most complex units found in hospitals due to the large number of processes and sub-processes associated, directly or indirectly, with the production of surgeries. Monitoring specific indicators for this unit can help develop management strategies that allow to re-evaluate and reorganize the activities of the surgical service, with the purpose of improving its efficiency[9].

Due to the characteristics of our hospital institution, numerous indicators can be used in the surgical block, some of them associated with infrastructure and others with processes and results. For an initial evaluation, we suggest the following objective criteria:

1. Number of surgical interventions performed.
2. Cancellation rate.
3. Starting time of the procedure.
4. Opportunity for surgical emergencies.
5. Starting time of anesthesia.
6. Starting time of surgery.
7. Time of admission to the UCPA/ICU.
8. Turnover or replacement time.
9. Proportion of operating rooms in use[10].

MATERIAL AND METHODS

With the approval of the Local Health Research Committee (CLIS), and in order to measure the indicators of efficient use of operating rooms, a retrospective longitudinal descriptive study was conducted on a group of 3,554 patients from our institution, using the information that had been recorded in their clinical files.

On a daily basis, the chief of the operating rooms is responsible for drawing up the surgical schedule, while the medical assistants are in charge of registering in said schedule the surgeries canceled and performed, and for each of them, the time of arrival of the patient to pre-anesthesia and the time of discharge from the operating room and/or the post-anesthesia care unit (PACU).

Inside the operating room, the circulating nurse, in agreement with the anesthesiologist, is tasked with fixing the time for the anesthetic-surgical procedure: time of admission to the operating room, start of anesthesia, start of surgery, end of surgery, end of anesthesia and transfer to the PACU.

The onset of the pandemic significantly impacted the services provided by our institution; thus, we decided to analyze the new environment for surgical activities. This is why we included in the study only those patients scheduled for surgery during the period from March 11, 2020 to March 31 of 2021.

The list of patients scheduled for surgery during our study period was obtained by reviewing the database of the surgical opportunity indicator (INDOQ). The name and social security number of each were recorded to draw up an initial list of patients. We then asked for the clinical files of these patients to the clinical file department and reviewed the copies of the operative reports of the anesthesiology service. These reports included the 4-30-27/90 forms «surgical interventions carried out in the operating room» and the 2430-021-076 forms «clinical records and nursing interventions of surgical patients». Applying the criteria for non-inclusion and exclusion of subjects, a definitive patient list was drawn up. Once this list was prepared, the clinical records of each patient

were checked to obtain the information needed to assess the variables under study. These variables included:

1. **Number of surgical interventions performed:** number of surgeries performed during the study period.
2. **Cancellation rate:** number of surgeries canceled on the day of surgery during one year, divided by the number of surgical procedures scheduled in the operating rooms in the same year and multiplied by one hundred.
3. **Surgery starting time:** time in minutes between the time a surgery was scheduled and the time it starts.
4. **Opportunity for surgical emergencies:** time in minutes between the request for an urgent operation in the operating room and the start of the surgery.
5. **Time for the start of anesthesia:** time in minutes between the moment the patient enters the operating room until the start of anesthesia.
6. **Time for surgery starts:** time in minutes between the moment anesthesia is administered and the start of surgery.
7. **Time for admission to the PACU/ICU:** time in minutes between the moment anesthesia ends and the moment the patient is admitted to the post-anesthesia care unit or the intensive care unit.
8. **Turnover or replacement time:** time in minutes between the moment a patient leaves the operating room for the recovery room or the intensive care unit and the moment the next patient enters for surgery.
9. **Rate of use of operating rooms:** time each operating room is occupied during the scheduled surgery day. Sum of the time it takes to perform each surgery plus turnover time, divided by the time available.

The data were collected using an easy-to-apply form. The process of identifying patient files was carried out by the resident anesthesiology physician.

The variables were analyzed using descriptive statistics: measures of central tendency and dispersion. Quantitative variables with normal distribution were described by arithmetic mean and standard deviation. Qualitative nominal variables were described by rates and proportions.

Table 1: Analysis of scheduled surgeries.

Surgeries	n (%)
Deferred	266 (7.48)
Performed	
• Elective	1,979 (55.68)
• Urgent	1,309 (36.84)
Total	3,554 (100.00)

Percentage calculated according to the total number of scheduled surgeries (N = 3,554)
Source: surgery reports.

Table 2: Causes of surgical deferral.

Causes	n (%)
No bed available	68 (25.6)
The patient did not show up	32 (12.0)
Intercurrent illness	25 (9.4)
Insufficient operating room time due to prolonged surgery	20 (7.5)
Priority given to emergency surgery	17 (6.4)
Change of surgical criteria	15 (5.6)
Surgery was moved forward	10 (3.8)
Intraoperative death	10 (3.8)
Incomplete study	6 (2.3)
Lack of special instruments or equipment (nonexistent)	6 (2.3)
Fasting was not obeyed	4 (1.5)
Lack of blood	4 (1.5)
By surgeon's indication	4 (1.5)
Internal medicine did not authorize	3 (1.3)
Absence of the anesthesiologist without warning	3 (1.3)
Change of clinical picture (surgical indication)	3 (1.3)
Change of anesthetic criteria	2 (0.7)
Cardiology did not authorize	2 (0.7)
Need for cardiological evaluation	2 (0.7)
Poorly prepared patient	2 (0.7)
Scheduling error	2 (0.7)
Insufficient nursery staff	1 (0.4)
Surgeon absence due to disability	1 (0.4)
Hematology did not authorize	1 (0.4)
Preanesthetic complication (due to medication)	1 (0.4)
No clinical file	1 (0.4)
Lack of authorization from the patient or person responsible	1 (0.4)
Patient under study in another area	1 (0.4)
Lengthened times	1 (0.4)
Patient deceased before surgery	1 (0.4)
Others	17 (6.4)
Total	266 (100.0)

Percentage calculated according to the total number of scheduled surgeries (N = 3,554)
Source: surgery reports.

The data were processed using the statistical program SPSS for Windows, version 25.0. The results were presented in tables and graphs.

RESULTS

A total of 3,554 surgeries (1,309 emergency surgeries and 1,979 elective surgeries) were scheduled in the period under study, of which 266 were deferred *(Table 1)*. The reported causes for surgery were as follows: lack of a bed (25.6%); the patient did not show up (12.0%); intercurrent disease (9.4%); other causes (53.0%), including insufficient operating room time due to a prolonged surgery, priority given to an emergency surgery, change of surgical criteria, another surgery was moved up in the schedule, etcetera *(Table 2)*.

Regarding the proportion of surgical procedures by specialty, ophthalmological surgeries had the highest percentage (27.24%), followed by urological surgeries

(20.26%) and neurological surgeries (17.53%) *(Figure 1)*. Of the surgeries performed, most were carried out during the morning shift *(Table 3)*. *Table 4* shows the time corresponding to each process of the surgical procedure.

During the period under study there were 296 days of surgical activity. The recorded surgical time was 27.70% active time and 72.30% inactive time.

DISCUSSION

During the SARS-CoV-2 (COVID-19) pandemic there has been a general trend towards an increase in the number of patients awaiting a surgical procedure. This represents a serious problem, since it significantly compromises the principle of equity that inspires public health systems around the world, giving rise to discontent and complaints by the users. It is thus necessary to monitor performance indicators in order to check whether medical institutions are meeting the population needs effectively, especially in this period of uncertainty.

Following institutional regulations saves time and resources; it also avoids conflicts[11]. Regulations indicate that the beginning of the surgical procedure should take 15 minutes[12], which differs significantly from what we observed (42.32 ± 37.04 min). Although it is true that this excess time at the beginning of the procedure is attributable to the changes in preoperative logistics induced by the pandemic, this could be improved by starting the intervention at the scheduled time in order to take full advantage of the time allotted to it. In the present study, only 106 procedures (2.98%) began at the scheduled time. Other authors reported longer starting times. Requesens et al[13]. reported an average of 67 minutes, while Martín-Pérez reported a starting time of 12.5 minutes[14].

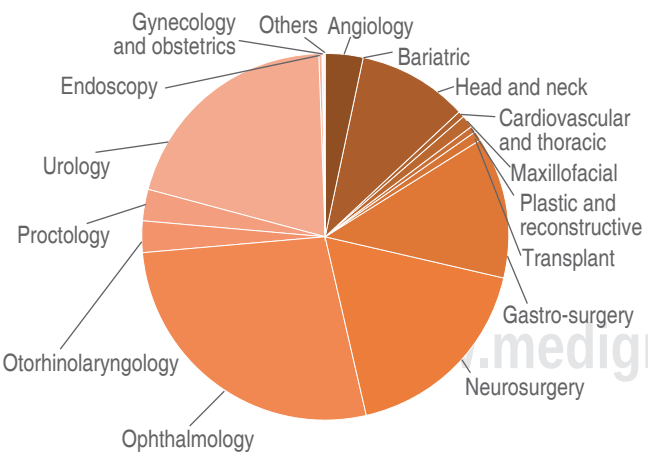

Figure 1: Surgeries by specialty.
Percentage calculated according to the total number of scheduled surgeries (N = 3,554).
Source: surgery reports.

Table 3: Analysis of surgeries by shift.

Surgeries	n (%)
Deferred	266 (7.48)
Performed	
Morning	2,213 (62.26)
Evening	767 (21.58)
Night	574 (16.16)
Total	3,554 (100.00)

Percentage calculated according to the total number of scheduled surgeries (N = 3,554).
Source: surgery reports.

Table 4: Surgical times.

Variable	Time (min)
Starting time of the procedure	42.32 ± 37.04
Opportunity for surgical emergencies	104.69 ± 102.55
Starting time of anesthesia	10.11 ± 9.85
Starting time of surgery	40.03 ± 24.68
Time of admission to the UCPA/ICU	15.35 ± 29.94
Turnover or replacement time	177.97 ± 174.33

PACU = post-anesthesia care unit. ICU = Intensive Care Unit.
Source: surgery reports.

Once the patient leaves the operating room, there needs to be a high degree of coordination between the team tasked with cleaning the operating room and the team getting the next patient into it, a process that should last 30 ± 15 minutes[15-19]. In our hospital institution, the average duration of this combined process was 104.69 ± 102.55 minutes. Other studies have shown that the prolongation of the turnover time has repercussions such as staff dissatisfaction, delays, use of overtime and cancellation of surgeries[20]. In this regard, the results of the present study are well above the time reported by other studies. Prieto et al[21]. reported a turnover time of 20 minutes, while Jerico MC[13] reported a turnover time of 50.2 minutes.

The correct operation of the surgical block can be measured by means of the index of operating room occupancy or surgical performance, which is the ratio between the surgical time used and the surgical time available on the same day in the same operating room[10]. Other authors reported significantly lower values[10,13,15-21]. This is ultimately attributable to the restrictions imposed by the COVID-19 throughout the world.

The efficient use of the operating room depends on the fulfillment of specific functions by all the personnel involved and on a strict adherence to scheduled times.

The performance of the operating rooms depends on the first case of the day beginning at the scheduled time, on minimizing turnover time, maintaining a low cancellation

rate, making few scheduling errors and drawing up a precise surgical schedule.

Surgery is an indispensable therapeutic alternative in medical practice; it saves lives and increases the survival of patients with degenerative and chronic pathologies. The number of surgeries during the COVID-19 pandemic will increase as new protection measures and equipment for health staff and patients facilitate and improve surgical procedures. However, it is essential to adapt to the new conditions, since the risk of infection by SARS CoV-2 is still present, adding to the complications inherent to these interventions. Institutional efforts are aimed at improving the response capacity of surgical teams in terms of the diversity of procedures and the timeliness with which surgical services are provided. In this work we report the impact of the COVID-19 pandemic on the intensity, diversity and dynamism of surgical activity in an institutional setting.

CONCLUSIONS

A surgical unit is made up of an entire work team, so good organization is required to manage resources appropriately. One of the most important resources is surgical time. Optimal use of the operating room depends on the efficient performance of the staff, which should take advantage of all the surgical time available to it and adhere to the schedule.

The results of the present study show that the time used by surgical teams in the institution under study does not conform with established standards, and differs enormously from the results published by other authors.

Regarding the management and organization of the surgical day, a significant improvement could be achieved by starting the first intervention of the day as closely to the scheduled time as possible, reducing turnover times and avoiding mistakes in the surgical schedule. These measures could be the key to a successful surgical unit.

Analyzing the time taken up by each surgical procedure, as this work has done, can undoubtedly help make an error-free surgical schedule. Knowing the average time of each surgical intervention and the average time for patient turnover can help make full use of all the time available for the surgical day, minimizing residual time, the prolongation of surgical procedures and cancellations due to lack of time.

As future lines of research, I propose the analysis of surgery times, of all specialties, with respect to certain clinical aspects of the patients and other aspects of the intervention, in order to observe if the study variables influence or not the duration of the intervention.

REFERENCES

1. Infobae. Una investigación dio con la fecha exacta del primer caso de coronavirus en el mundo [Internet] [Consultado: 21 de enero de 2020]. Disponible en: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiEi_uMya7uAhVFbKwKHaDXB4wQFjAAegQIBBAC&url=https%3A%2F%2Fwww.infobae.com%2Famerica%2Fmundo%2F2020%2F03%2F13%2Funa-investigacion-dio-con-la-fecha-exacta-del-primer-caso-de-coronavirus-en-el-mundo%2F&usg=AOvVaw0cOlel7kqj7Ar_CtKQKfPZ
2. Ren LL, Wang YM, Wu ZQ, Xiang ZC, Guo L, Xu T. Identification of a novel coronavirus causing severe pneumonia in humans : a descriptive study. Chin Med J. 2020;133:1015-1024.
3. Bogoch II, Watts A, Thomas-Bachli A, Huber C, Kraemer MU, Kamran K. Pneumonia of unknown etiology in Wuhan, China: potential for international spread via commercial air travel. J Trav Med. 2020;27:taaa008.
4. Suárez V, Suarez-Quezada M, Ruiz O, Ronquillo EJ. Epidemiología de COVID-19 en México: del 27 de febrero al 30 de abril de 2020. Rev Clin Esp. 2020;220:463-471.
5. Ministerio de Sanidad, Consumo y Bienestar Social-Profesionales-Enfermedad por nuevo coronavirus, COVID-19 [Internet] [Consultado: 21 de enero de 2021]. Disponible en: https://www.mscbs.gob.es/en/profesionales/saludPublica/ccayes/alertasActual/nCov-China/home.htm
6. Mose-Balibrea J, Mose-Badia J, Rubio-Pérez I, et al. Manejo quirúrgico de pacientes con infección por COVID-19. Recomendaciones de la Asociación Española de Cirujanos. R Esp. 2020;98(5):251-259.
7. Iacobucci G. Covid-19: all non-urgent elective surgery is suspended for at least three months in England. BMJ. 2020;368:m1106. doi: 10.1136/bmj.m1106
8. Di Martino M, García-Septiem J, Maqueda-González R et al. Cirugía electiva durante la pandemia por SARS-CoV-2 (COVID-19): análisis de morbimortalidad y recomendaciones sobre priorización de los pacientes y medidas de seguridad. Cir Esp. 2020;98:525-532.
9. Carvalho-Jericó M, Galan-Perroca M, Colombo da Penha V. Mensuración de indicadores de calidad en un centro quirúrgico: tiempo de limpieza e intervalo entre cirugías. Rev. Latino-Am. Enfermagem. 2011;19:1-8.
10. Serra-Sutton V, Solans-Domènech M, Espallargues-Carreras M. Eficiencia en la utilización de bloques quirúrgicos. Definición de indicadores. Madrid: Plan de Calidad para el Sistema Nacional de Salud. Ministerio de Ciencia e Innovación. 2011; p 105.
11. Johnson BK, James CW, Ritchie G, Morgan RR Jr, McMillan HR. Evaluation of cost reduction measures at a state University Medical Center. J S C Med Assoc. 2014;110(1):8-11. Disponible en: https://www.ncbi.nlm.nih.gov/pubmed/27125004
12. Procedimiento para la planeación, programación, atención preoperatoria, transoperatoria y posoperatoria en las unidades médicas hospitalarias de tercer nivel de atención 2430 003 006. [Internet] [Consultado: 21 de febrero de 2021]. Disponible en: https://www.google.com/l?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjvhNv1_PvuAhVGUK0KHbcHBQEQFjAAegQIARAD&url=http%3A%2F%2Frepositorio.imss.gob.mx%2Fnormatividad%2FDNMR%2FProcedimiento%2F2660-003-063.pdf&usg=AOvVaw2MX8YDSQkorQMc-RKpzkB7
13. Requesens E, Vega G, Montes B, Aburto M, Cedillo L. Tiempo perdido entre cirugías y su repercusión en el cumplimiento de la programación quirúrgica del Hospital General de Querétaro. Cirujano general. 2008;30(4):220-223.
14. Martín-Pérez J. Análisis de los tiempos quirúrgicos de las intervenciones de cirugía general y digestivo. Universidad de

Zaragoza. 2014. [Internet] [Consultado: 21 de febrero de 2021]. Disponible en: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwixx--6gfzuAhUOWqwKHX0rAdsQFjAAegQIARAD&url=https%3A%2F%2Fcore.ac.uk%2Fdownload%2Fpdf%2F289975217.pdf&usg=AOvVaw2Jzvt6OrhuPX_7fJywa9g4

15. Dexter F, Epstein RH, Marcon E, Ledolter J. Estimating the incidence of prolonged turnover times and delays by time of day. Anesthesiology. 2005;102:1242-1248.
16. Dexter F, Macario A, O'Neill L. Scheduling surgical cases into overflow block time - computer simulation of the effects of scheduling strategies on operating room labor cost. Anesth Analg. 2000;90:980-988.
17. Gómez-Arnau J, González A. Principios generales de organización y gestión clínica de un bloque quirúrgico. Rev Esp Anestesiol Reanim. 2001;48:180-187.
18. Dexter F, Abouleish AE, Epstein RH, Whitten CW, Lubarsky DA. Use of operating room information system data to predict the impact of reducing turnover times on staffing costs. Anesth Analg. 2003;97:1119-1126.
19. Adams RRN, Warner P, Hubbard B, Goulding T. Decreasing turnaround time between general surgery cases: a six sigma initiative. J Nurs Adm. 2004;34:140-148.
20. Tyler DC, Pasquariello CA, Chen CH. Determining optimum operating room utilization. Anesth Analg. 2003;96:1114-1121.
21. Prieto P, Muñoz E, Royuela C, Ayuso D. Estudio de la actividad quirúrgica: una herramienta de registro de tiempos. Rev Calidad Asistencial. 2003; 18: 115-24. doi: 10.1016/S1134-282X(03)77585-X.