Efficiency estimation on the use of elective surgical theaters in the Chilean public health system from 2018 to 2021

Maximiliano Barahona[a]*, Marcela Cárcamo[b], Macarena Barahona[a], Cristian Barrientos[a], Carlos Infante[a], Álvaro Martínez[a]

[a] Departamento de Ortopedia y Traumatología, Universidad de Chile, Santiago, Chile
[b] Departamento de Epidemiología y Estudios en Salud, Universidad de los Andes, Santiago, Chile

*** Corresponding author**
mbarahona@hcuch.cl

Citation
Barahona M, Cárcamo M, Barahona M, Barrientos C, Infante C, Martínez Á. Efficiency estimation on the use of elective surgical theaters in the Chilean public health system from 2018 to 2021. *Medwave* 2023;22(2):e2667

DOI
10.5867/medwave.2022.02.2667

Submission date
Sep 16, 2022
Acceptance date
Feb 21, 2023
Publication date
Apr 3, 2023

Keywords
Surgery cancellation, elective surgery, Operating room efficiency, Operating room management, Chile

Postal address
Carlos Lorca Tobar 999 3er piso sector B oficina 351 Independencia, Santiago, Chile

Abstract

Objective

The efficient use of wards intended for elective surgeries is essential to resolve cases on the surgical waiting list. This study aims to estimate the efficiency of ward use in the Chilean public health system between 2018 and 2021.

Methods

The design was an ecological study. Section A.21 of the database constructed by the monthly statistical summaries that each public health network facility reported to the Ministry of Health between 2018 and 2021 was analyzed. Data from subsections A, E, and F were extracted: ward staffing, total elective surgeries by specialty, number, and causes of cancelation of elective surgeries. Then, the surgical performance during working hours and the percentage of hourly occupancy for a working day was estimated. Additionally, an analysis was made by region with data from 2021.

Results

The percentage of elective wards relative to staffed wards ranged from 81.1% to 94.1%, while those enabled in relation to staffed wards ranged from 70.5% to 90.4% during 2018 and 2021. The total number of surgeries was highest in 2019 (n = 416 339), but for 2018, 2020, and 2021 it ranged from 259 000 to 297 000. Cancelations ranged between 10.8% (2019) and 6.9% (2021), with the leading cause being patient-related. When analyzing the number of cases canceled monthly by facility, we saw that the leading cause was trade union-related. The maximum throughput of a ward intended for elective surgery was reached in 2019 with 2.5 surgeries; in 2018, 2020, and 2021, the throughput was around two surgeries per enabled ward for elective surgery. The percentage of ward time occupied during working hours as compared to a contract day ranged from 80.7% (2018) and 56.8% (2020).

Conclusions

All the parameters found and estimated in this study show an inefficient utilization of operating rooms in Chilean public healthcare facilities.

Main messages

- Efficient use of wards for elective surgery is key to resolving waiting lists.
- The length of waiting lists is used as an indicator of unmet needs, inadequate resources, or administrative inefficiencies.
- This work contributes to the knowledge of the factors that will allow the development of national and regional strategies to improve ward efficiency, directly impacting surgical waiting lists in the Chilean reality.
- The limitations of this work are related to the type and consistency of the data routinely collected by the Department of Health Statistics and Information.

Introduction

The surgical waiting list is a valid indicator and patient compilation tool that shows the excess demand for medical services over the available supply in a geographic area. The waiting list length is often used as an indicator of unmet needs, inadequate resources, or administrative inefficiencies. Waiting lists are inherent to any healthcare system where direct payment does not provide access to a physician's medical assistance [1]. Even before the pandemic, it was a problem for world-renowned healthcare systems such as that of the United Kingdom [2].

According to the latest report of the Ministry of Health, 260 135 people (59.2% women) were on the surgical waiting list as of March 31st, 2021, corresponding to 291 207 interventions. That same report gives an average waiting time of 558 days, i.e., 1.5 years [3]. The most frequent pathology on the waiting list was cholecystectomy, followed by knee arthroplasty, with a median waiting time of 2.5 years [4].

Strategies have been proposed for prioritizing surgical waiting lists based on national strategies and implemented according to local circumstances. In addition, general principles should be followed, incorporating parameters based on specialty and pathology [5]. However, increased efficiency in using wards for these pathologies is a strategy that has been little studied in Chile. Estay et al. [6] showed that pathologies excluded from the Explicit Health Guarantees Law (GES) have heterogeneous and higher waiting times than those reported by countries belonging to the Organization for Economic Cooperation and Development (OECD). In addition, they proposed strategies to solve this problem, emphasizing the strengthening of primary care but without considering better management of the use of wards for elective surgeries [6].

The provision and use efficiency of elective surgery wards are crucial for resolving cases on the surgical waiting list. There is no single parameter to define ward efficiency [7]. Pandit et al. [8] defined ward efficiency as the combination of three factors: maximizing the use of scheduled time in a day, minimizing the number of prolonged wards, and minimizing suspensions. On the other hand, Macario [7] proposes to determine efficiency according to six parameters: delay in the start of the first surgery, cost per ward hour, percentage of wards with a turnover time greater than 60 minutes, turnover time, ward use in relation to staff time, and the ratio between the estimated time and the actual surgery time.

The Chilean Public Health System wards are for emergency, gynecological-obstetric, elective, and undifferentiated care. Emergency wards are intended to resolve pathologies consulted in emergency services or complications of hospitalized patients. The gynecological-obstetric wards are intended for interventions in this specialty, mainly deliveries. The elective wards are used to resolve pathologies that, given their nature, allow the surgery date to be programmed in advance, being the usual way of resolving cases on the surgical waiting list. Undifferentiated wards are used to treat emergency or elective pathologies and are a strategy used by centers with a low volume of emergency pathologies. According to the Manual of Monthly Statistical Summaries of the Chilean Ministry of Health, it is not recommended to designate wards in this modality to high complexity centers [9].

Identifying gaps makes it possible to diagnose the current situation and define strategies for improvement [10]. Knowing the daily throughput of surgical wards for elective surgeries, the number of hours occupied, and the causes of cancelations will help define national and regional strategies to improve the efficiency of wards, with a direct impact on surgical waiting lists [11]. The COVID-19 pandemic has been a significant cause of a decline in elective surgeries and ward occupancy. A recent study showed that the incidence of knee arthroplasty (the second leading cause of surgical waiting list) decreased by more than 60% during the first year of the pandemic [12]. However, there are several publications guiding a safe return to performing elective surgeries with results similar to the pre-pandemic era [13–15]. Therefore, it would be expected that in 2021 ward efficiency will be similar to pre-pandemic.

The overall objective of this study is to estimate the efficiency of ward use in the Chilean public health system between 2018 and 2021. First, we describe the provision of elective wards, the number of surgeries performed, and the number and cause of cancelations. Then, the efficiency of the use of elective wards will be estimated using as parameters the percentage of occupancy of elective ward hours available in working hours, the number of daily surgeries per elective ward, and the percentage of cancelations between 2018 and 2021.

Methods

Ecological study. We analyzed the database constructed by the Monthly Statistical Summaries (REM) that each Chilean public health network facility reported to the Ministry of Health between 2018 and 2021. These are available in the open data of the Department of Statistics and Information in Health (DEIS) (https://deis.minsal.cl/#datosabiertos). Section A.21 contains the following three subsections:

1) Subsection A: installed capacity and utilization of operating rooms.
2) Subsection E: process management of surgical patients with elective surgery.
3) Subsection F: causes of cancelation of elective surgeries.

The monthly data for these three subsections were extracted using the ACCESS program (Microsoft®). The exploratory data analysis showed no missing data and only inconsistency in the percentages of authorized and occupied wards (less than 5%). In the case of finding an occupancy or habilitation above 100% of the staffing, it was considered inconsistent data. It was agreed among the authors to consider this data as 100% occupancy or habilitation. This bias only affects the results of part "a" and does not affect the other results.

Qualitative variables were reported in absolute frequencies and percentages; quantitative variables were reported as mean and standard deviation. The data were processed in the STATA v17 program. The analysis of the work was divided into five parts:

a. Staffed wards

The Monthly Statistical Summaries series methodological guide [9] defines "staffed wards" as those reported by resolution, installed, and available for use in accordance with the Regional Secretariat of the Chilean Ministry of Health, with no fluctuation in the number of wards for temporary reasons. Meanwhile, authorized wards correspond to those with the infrastructure and equipment available to function, and active or working wards correspond to those authorized with human resources. Both authorized and active wards show monthly fluctuations in their number. The data for this analysis were extracted from subsection A, which corresponds to "Staffed wards": "staffed wards", "average monthly number of authorized wards", "average monthly number of functioning operating rooms (referred to as "active") and "total monthly number of operating ward hours". This last variable is reported for both working and non-working hours. According to the Monthly Statistical Summaries methodological guide [9], the working hours are of 8.75 hours from Monday to Friday, with these hours being broken down between 8 a.m. and 5 p.m. from Monday to Thursday and from 8 a.m. to 4 p.m. on Fridays. Non-working hours correspond to the use of the ward from Monday to Thursday from 5:00 p.m., Fridays from 4:00 p.m., or the use of wards on holidays and weekends. In addition, in subsection A, each of the variables reported is broken down by type of use assigned to the ward: elective, emergency, obstetric, and undifferentiated.

b. Total number of surgeries and surgeries by subspecialty

Data from subsection E were used for this category. These data are broken down into the following subspecialties: general surgery, cardiovascular surgery, maxillofacial surgery, thoracic surgery, traumatology, neurosurgery, otolaryngology, ophthalmology, obstetrics and gynecology, gynecology, urology, and other specialties. "obstetrics and gynecology" and "gynecology" were grouped at the time of analysis. This section details the number of elective surgeries; however, it was impossible to know whether they were performed during working or non-working hours or the type of ward in which they were performed. The monthly statistical summary report does not have a section detailing the number of emergency surgeries.

c. Cancelation of elective surgeries from 2018 to 2021

This item uses data from subsection F, which details the absolute number of cancelations by cause category in each institution by month. The causes of cancelation are grouped into the following categories: "patient", "administrative", "clinical support unit", "surgical team", "infrastructure", "emergencies," and "union". Table 1 details the categories of cancelation causes according to the Methodological Guide for the Monthly Statistical Summary series [9].

The percentage of cancelations was calculated using the absolute number of cancelations as the numerator, the sum of the absolute number of surgeries, and the absolute number of cancelations as the denominator. It was observed that not all institutions reported cancelations in each category. To estimate the impact of each cause of cancelation, these were summed and then divided by 12 and by the number of institutions reporting that cause. This indicator was called "average monthly cancelation per institution": average monthly cancelation per cause = ((number of cancelations in a year for cause "i"/12 months)/ number of institutions reporting cause "i").

d. Estimated elective ward throughput from 2018 to 2021

For this estimation, it was assumed that all reported elective surgeries, except for gynecological surgeries, were performed in wards intended for elective surgery. This is an optimistic approach since it assumes that undifferentiated wards were used only for emergency surgeries. On the other hand, it is assumed that the operating output is homogeneous, i.e., that the surgical output in elective surgeries per hour is the same during working hours as during non-working hours. Finally, the number of available elective wards was used for this estimation, not the total number of available wards (staffed).

First, the number of gynecological surgeries was subtracted from the total number of reported elective surgeries since these are performed in gynecological wards, not elective wards. Given

Table 1. Categories of cancelation causes according to the Methodological Guide of the MSS series.

Cause	Detail
Emergencies	1. Natural disasters 2. Ward destruction 3. Fires/floods 4. Bomb warning 5. Health emergency
Patient	1. Not showing up, unable to be located, delayed admission, or death before surgery 2. Refuses surgery or does not sign the consent form 3. Acute or chronic condition that contraindicates surgery 4. Lack of fasting or preparation (e.g., intestinal) 5. Altered preoperative examinations or failure to suspend anticoagulation 6. Lack of evaluation by another specialty, incomplete preoperative study, or no surgical indication.
Administrative	1. Scheduling error 2. No space in the recovery or critical patient unit 3. Absence of appointed legal guardian 4. Replaced due to emergency
Clinical support unit	1. Sterilization failure or incomplete instrumentation 2. Non-operational equipment 3. Lack of blood bank stock or critical medication 4. Lack of supplies or insufficient stock 5. Lack of coordination with imaging or pathological anatomy
Surgical team	1. Lack of surgeon, paramedical technician, anesthesiologist, or non-physician professional 2. Prolongation of surgical times
Infrastructure	1. Lack of cleaning staff 2. Failure due to power failure, clinical gases, air conditioning, or humid network. 3. Elevator failure
Union	1. Strike or staff mobilization

MSS: Monthly Statistical Summary.
Source: Methodological Guide from the Monthly Statistical Summary series.

that the number of facilities reporting the provision and use of wards does not match the number of facilities that report the number of elective surgeries, the number of elective surgeries performed in facilities that report the number of available elective wards ("cxest") was estimated using the following formula: cxest = (number of elective surgeries/number of facilities reporting elective surgeries) * (number of facilities reporting authorized elective wards).

Next, the number of hours needed for each elective surgery performed ("hrcx") was calculated by dividing the total effective occupation hours in elective surgeries (skilled and unskilled) by the "cxest": *hrcx = total hours occupied in elective surgeries/cxest*.

The effective hours are those spent in the surgery itself, i.e., excluding ward turnover time (cleaning, anesthesia of the patient).

On the other hand, the number of effective working hours spent in elective wards was used for elective surgeries (without gynecological). Again, given that the number of facilities reporting staffed wards and use does not match the number of facilities reporting elective surgeries, the number of working hours was estimated as follows: tothabilest = ((effective working hours in institutions reporting wards * institutions reporting surgery)/(institutions reporting staffed wards).

Next, we calculated the mean daily amount of effective occupation hours of an authorized ward by dividing the "tothabilest" estimator by the total number of authorized wards and by the number of working days of the year: *hrhabilest = tothabilest/authorized wards/working days of the year*.

Finally, to estimate the number of daily elective surgeries performed per authorized ward on a working day ("ward throughput"), *hrhabilest* was divided by *hrcx: ward throughput = hrhabilest/hrcx*.

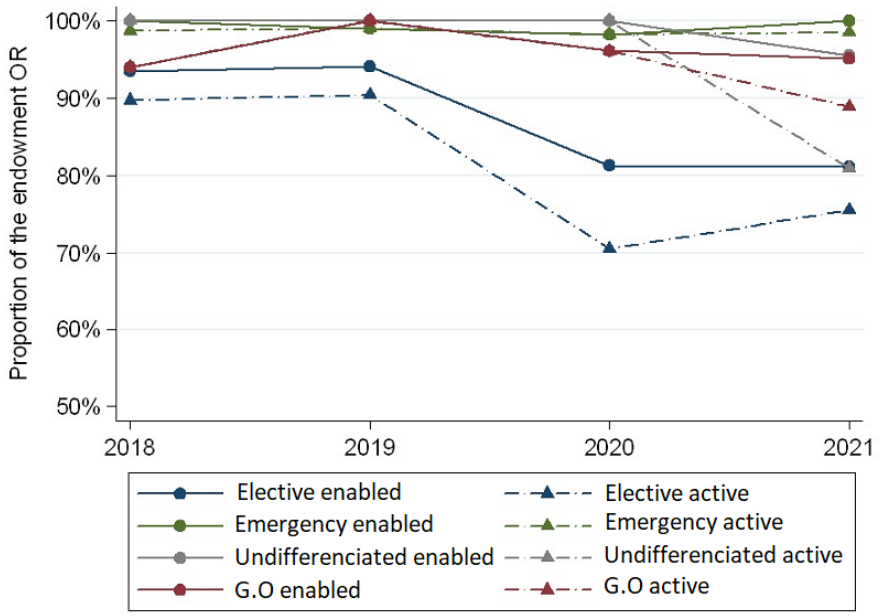
In addition, the total effective time of surgery during working hours reported and the total time spent on preparation during working hours were added, obtaining the proportion of time in relation to that spent on preparation:

Proportion of ward preparation hours during working hours = total hours spent on ward preparation during working hours/(total hours of elective ward effective use during working hours + total hours spent on elective ward preparation during working hours).

This time was added to the estimated number of daily ward hours. With this, the effective ward occupancy in a working day was calculated, which according to the Monthly Statistical Summaries methodological guide, is of 8 hours and 45 minutes per day (45 minutes corresponds to ¾ of an hour, therefore 8.75):

Figure 1. Percentage of enabled and active wards by type and year compared to the total number of wards.

G.O = Gynecological-obstretic.



Source: Prepared by the authors based on the study results.

Percentage effective ward occupancy = ((daily surgery hours during working hours + (daily surgery hours in skilled hours * proportion of preparation hours during working hours))/ working day 8.75).

e. Analysis by region 2021: staffing and suspensions

For this purpose, parts "a" and "c" were analyzed for each region of the country in 2021.

Results

a. Staffed wards from 2018 to 2021

The total number of wards varied from 679 in 2018 to 695 in 2021. Out of the total number of wards in our country, those destined for elective surgery accounted for 73.9% in 2018; 74.1% in 2019; 74.3% in 2020, and 76.1% in 2021. The percentage of authorized wards is lower in elective wards than in the other types of wards, the difference being greater in 2020 and 2021, where the percentage was 81.1% and 81.3%, respectively (Figure 1). For active wards, this percentage is even lower. In 2018 and 2019, it was reported that 90% of the wards were active, while in 2020 and 2021, only three out of four were active (Figure 1).

b. Total number of surgeries and surgeries by subspecialty from 2018 to 2021

The total number of elective surgeries was higher in 2019 (n = 416 339), performed in 99 facilities. Similar numbers were reported in 2018 and 2021, reaching 297 000 surgeries. However, in 2021 four additional facilities reported the number of surgeries.

The largest proportion of wards is destined for general surgery (range 26.0% to 28.2%), followed by orthopedics and traumatology (range 14.7% to 18.6%) and ophthalmology (range 12.2% to 16.1%) (Table 2).

c. Cancelation of elective surgeries from 2018 to 2021

The percentage of cancelations decreased from 12.9% in 2018 to 6.4% in 2021. When analyzing the average monthly cancelations by each center, it was estimated that 9.7 patients (SD 13.0) canceled in 2018, while 5.7 (6.8) in 2021 (Table 3).

An analysis of the total number of cancelations revealed that the cause "patient" is the most common, accounting for almost half. Problems with the "surgical team" was the second cause (one in every five cancelations) (Figure 2).

However, when analyzing the indicator "average monthly number of cancelations per institution", it is observed that the cause "union" has a higher number of cancelations per month since 2019, ranging between 11 in 2021 and 18 in 2019. In 2018 it ranked second, surpassed by "patient" (Figure 3). This

Table 2. Total number of surgeries, institutions reporting elective procedures, and distribution by subspecialty between 2018 and 2021.

	2018	2019	2020	2021
General surgery	83 844 (28.2%)	112 491 (27.0%)	68 345 (26.3%)	77 295 (26.0%)
Cardiovascular surgery	10 253 (3.4%)	15 416 (3.7%)	10 626 (4.1%)	11 573 (3.9%)
Maxillofacial surgery	3971 (1.3%)	6047 (1.5%)	3680 (1.4%)	4908 (1.6%)
Thoracic surgery	1914 (0.6%)	2700 (0.6%)	2272 (0.9%)	2623 (0.9%)
Orthopedics and Traumatology	43 800 (14.7%)	65 898 (15.8%)	48 165 (18.6%)	54 856 (18.4%)
Neurosurgery	7568 (2.5%)	11 426 (2.7%)	7552 (2.9%)	8030 (2.7%)
Otorhinolaryngology	15 833 (5.3%)	20 608 (4.9%)	9345 (3.6%)	10 945 (3.7%)
Ophthalmology	36 228 (12.2%)	67 086 (16.1%)	37 708 (14.5%)	45 715 (15.4%)
Obstetrics and Gynecology	50 787 (17.1%)	60 782 (14.6%)	38 456 (14.8%)	42 034 (14.1%)
Urology	23 448 (7.9%)	31 826 (7.6%)	19 093 (7.3%)	21 701 (7.3%)
Others	20 046 (6.7%)	22 059 (5.3%)	14 316 (5.5%)	17 862 (6.0%)
Total	297 692	416 339	259 558	297 542
N establishments[1]	94	99	96	98

N: number.
[1]N establishments: Number of establishments reporting elective surgeries.
Source: Prepared by the authors based on the study results.

difference regarding the total number of cancelations is due to the underreporting of this cause; the "patient" cause is reported in all centers, but the "union" cause was only reported in 25% of facilities in 2021 and 61% in 2019.

D. Estimated elective ward throughput from 2018 to 2021

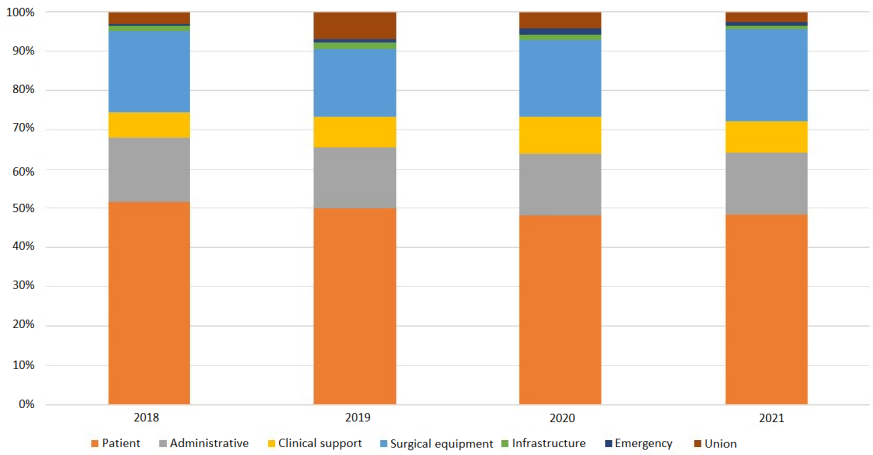
The highest throughput of elective surgeries per ward was

Table 3. Elective ward cancelations between 2018 and 2021 by cause.

Cancelations		2018	2019	2020	2021
Reported interventions		297 692	416 339	259 558	297 542
Total cancelations		44 115 (12.9%)	38 654 (8.4%)	18 667 (6.8%)	20 383 (6.4%)
Patient	Total	22 705 (51.5%)	19 327 (50.1%)	8973 (48.1%)	9845 (48.4%)
	Monthly average[a]	20,32 (SD 18.2)	15,8 (SD 17.2)	9,46 (SD 9.3)	9,42 (SD 9.1)
	N reports[b]	94	99	96	98
Administrative	Total	7310 (16.6%)	5996 (15.5%)	2964 (15.9%)	3199 (15.7%)
	Monthly average[a]	7.72 (SD 8.5)	7.4 (SD 6.2)	4.55 (SD 4.4)	3.60 (SD 4.0)
	N reports[b]	94	99	96	98
Clinical support	Total	2749 (6.2%)	2905 (7.5%)	1743 (9.3%)	1640 (8.0%)
	Monthly average[a]	3.4 (SD 2.3)	4.6 (SD 6.8)	3.01 (SD 2.7)	2.24 (SD 2.9)
	N reports[b]	94	99	96	98
Surgical equipment	Total	9139 (20.7%)	6768 (17.5%)	3639 (19.5%)	4794 (23.5%)
	Monthly average[a]	8.9 (SD 8.8)	3.9 (SD 4.0)	5.03 (SD 4.9)	5.10 (SD 5.8)
	N reports[b]	94	99	96	98
Infrastructure	Total	608 (1.4%)	566 (1.5%)	259 (1.4%)	198 (1.0%)
	Monthly average[a]	3.4 (SD 2.8)	4.5 (SD 5.2)	4.13 (SD 4.7)	4.01 (SD 3.4)
	N reports[b]	52	61	32	25
Emergency	Total	201 (0.5%)	332 (0.9%)	324 (1.7%)	171 (0.8%)
	Monthly average[a]	3.8 (SD 3.4)	18.3 (SD 14.1)	4.13 (SD 4.9)	2.40 (SD 2.9)
	N reports[b]	52	61	32	25
Union	Total	1364 (3.1%)	2711 (7.0%)	765 (4.1%)	533 (2.6%)
	Monthly average[a]	12.4 (SD 16.5)	18.3 (SD 14.1)	10.68 (SD 9.9)	10.50 (SD 9.4)
	N reports[b]	52	61	32	25

SD: standard deviation.
[a]Indicator "monthly average cancelations by cause". [b]Number of institutions reporting the cause of cancelation.
Source: Prepared by the authors based on the study results.

Figure 2. Percentage of the total number of cancelations per year by cause.



Source: Prepared by the authors based on the study results.

achieved in 2019, performing an average of 2.53 surgeries a day per ward. However, in 2018, 2020, and 2021 the performance was similar, varying between 1.92 and 2.09 surgeries a day per ward (Table 4).

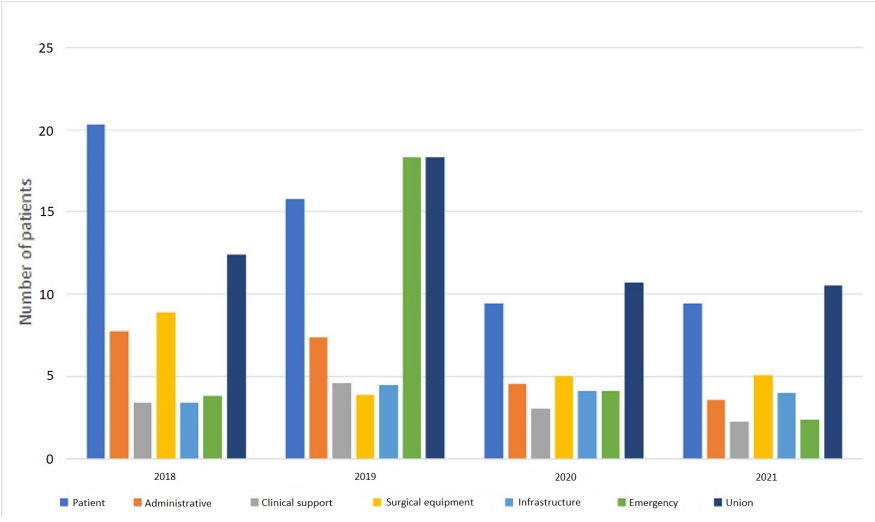
In 2018, the highest percentage of effective ward occupancy of a working day (80.7%) was reached. 2020 and 2021 had the lowest effective occupancy percentages, reaching 56.8% and 60.2%, respectively (Table 4).

E. ANALYSIS BY REGION 2021: STAFFING AND CANCELATIONS

The largest number of wards is in the Metropolitan Region, with 200 (38%), followed by the Valparaíso Region (n = 55.10%) and Biobío (n = 52.10%). The regions of Tarapacá and Aysén have the lowest percentage of enabled and active wards, below 60% (Table 5).

The main cause of cancelation, according to the indicator "average monthly cancelations per institution" was heterogeneous across Chile's regions. In the Atacama and Aysén regions, it was the "infrastructure" cause, while the "patient" cause was the lowest. The Antofagasta region presented the cause "patient" as the main reason in the "average monthly number of cancelations per institution" indicator. On the other hand, the cause "surgical equipment" had the highest value in the regions of Tarapacá, Coquimbo, and Magallanes. The "union" cause was reported only in the regions of Tarapacá, Coquimbo, Valparaíso, O'Higgins, Biobío, Metropolitan, and Los Ríos, exceeding 10 cancelations per month in four of them (Tarapacá, Coquimbo, O'Higgins, and Biobío) (Table 6).

Figure 3. Shows the indicator "average monthly cancelations per reporting facility" in each facility by cause and by year.



Source: Prepared by the authors based on the study results.

Table 4. Summary of indicators and parameters used in the ward efficiency estimation segment.

	2018	2019	2020	2021
Elective ward throughput	1.92	2.53	1.90	2.09
Effective occupancy hours on working days	7.1	6.5	5.0	5.3
Percentage effective ward occupancy in relation to working days (8.75hrs)	80.7%	73.9%	56.8%	60.2%
Number of enabled wards	470	481	414	429
Number of institutions reporting staffed wards	88	88	89	92
Number of institutions reporting elective surgeries	94	99	96	98
Total number of elective surgeries excluding gynecological surgeries	246 905	355 557	221 102	255 508
"cx est" indicator	231 145	316 051	204 980	239 865
Total number of ward hours occupied in elective surgery	706 547	678 599	449 822	508 143
"hrcx" estimator	3.1	2.14	2.19	2.12
Total ward hours occupied during working hours for elective surgery without preparation	640 163	579 866	403 510	449 128
"tothábilest" indicator	683 810	652 350	435 248	478 419
Working days per year	248	250	252	252
Number of enabled wards	470	481	414	429
"hrhabilest" indicator	5.87	5.42	4.17	4.43
Proportion of ward time spent on ward preparation time	0.17	0.17	0.16	0.17

cx est: *cxest = (number of elective surgeries/number of facilities reporting elective surgeries) * (number of facilities reporting enabled elective wards).* hrcx: *hrcx = total hours occupied in elective surgeries/cxest.*. tothabilest: *tothabilest = (effective working hours in institutions reporting ward * institutions reporting surgeries)/(institutions reporting staffed wards).* hrhabilest: year: *hrhabilest = tothabilest/enabled wards/ working days per year.*
Source: Prepared by the authors based on the study results.

DISCUSSION

This study shows that the use of wards for elective surgeries in our country requires urgent management interventions to improve their performance and decrease the surgical waiting list. Increasing the effective use of existing wards is probably more cost-effective than investing in more infrastructure that would function in the same way as the existing ones, with a significant impact in the short term, as opposed to building more wards.

Table 5. Distribution of elective staffed wards and proportion of enabled elective wards occupied by region in 2021.

Region	Number of establishments	Staffed electives[1]	Enabled proportion[2]	Occupied proportion[3]	Occupied/Enabled
Tarapacá	1	8 (2%)	0.52	0.52	1
Antofagasta	5	19 (4%)	0.75	0.7	0.93
Atacama	2	7 (1%)	0.86	0.65	0.76
Coquimbo	4	21 (4%)	0.73	0.7	0.97
Valparaíso	12	55 (10%)	0.72	0.62	0.86
O`Higgins	5	23 (4%)	0.85	0.78	0.92
Maule	7	28 (5%)	0.88	0.67	0.76
Biobío	11	52 (10%)	0.84	0.79	0.95
Araucanía	9	42 (8%)	0.74	0.74	1
De los Lagos	6	26 (5%)	0.86	0.63	0.73
Aysén	3	5 (1%)	0.59	0.59	1
Magallanes	3	10 (2%)	0.88	0.56	0.63
Metropolitan	30	200 (38%)	0.86	0.86	1
Los Ríos	4	14 (3%)	0.8	0.65	0.81
Arica	1	7 (1%)	0.75	0.73	0.98
Ñuble	5	13 (2%)	0.71	0.7	0.98
Chile	108	529 (100%)	0.81	0.75	0.93

[1]Staffed wards are those enabled by the corresponding local authority and do not have monthly variations.
[2]The proportion of enabled wards is in relation to the staffing of each institution. They correspond to wards with the necessary equipment and may vary over time.
[3]The proportion of occupied wards is in relation to the staffing of each institution, corresponding to wards with the necessary equipment and human resources, and may vary over time.
Source: Prepared by the authors based on the study results.

Table 6. Shows the indicator "average monthly number of cancelations per institution" for each cause in each region of Chile in 2021.

Region	Patient	Administrative	Clinical support	Surgical team	Infrastructure	Emergency	Union
Chile	9	4	2	5	4	2	11
Tarapacá	10	4	3	10	ND	ND	ND
Antofagasta	17	6	37	5	7	ND	ND
Atacama	5	2	1	2	2	ND	ND
Coquimbo	10	4	3	9	4	3	12
Valparaíso	6	4	2	5	2	2	5
O'Higgins	8	7	3	4	1	3	13
Maule	8	2	2	4	1	ND	ND
Biobío	8	5	3	5	2	3	10
Araucanía	8	3	3	4	3	1	ND
Los Lagos	4	3	4	5	4	5	ND
Aysén	3	2	2	2	9	4	ND
Magallanes	8	4	2	12	1	3	ND
Metropolitan	14	5	4	8	4	3	9
Los Lagos	3	4	2	5	1	ND	9
Arica	14	4	2	6	6	ND	ND
Ñuble	9	6	2	3	ND	ND	ND

ND: Does not report cancelations for this cause.
Source: Prepared by the authors based on the study results.

There is no single parameter to define whether a ward is efficient, so it is necessary to review the entire ward workflow, considering the health user, human resources needed for the surgery, and the available infrastructure. Regarding the latter, the first aspect detected in this study is that it is necessary to increase the proportion of available wards in relation to the number of staffed wards to maximize the use of the available infrastructure. Both emergency, obstetric and undifferentiated wards have a higher percentage of available and active wards than elective surgery wards. Probably the biggest problem during 2021 was absenteeism [16]. However, 90% of active wards in 2018 and 2019 was also lower than that reported for wards intended for other use.

On the other hand, this study shows that effective ward occupation during working hours does not exceed 80% of the working day of 8.75 hours. This means that the scheduling strategy of the wards is deficient. An efficient ward is considered when this percentage is above 90% [7], far from what was found in this analysis, even before the pandemic. The use of documented times for ward scheduling is key, so the use of technology and the implementation of algorithms that allow better use of contracted staff time are 21st-century strategies that must be implemented urgently [17,18]. Likewise, this makes it possible to optimize another efficiency parameter that could not be measured in this study: the surgeon's underestimation of the time needed for surgery, which should not be more than 15 minutes. Again, having a record of the historical duration of surgeries, both by the team and by individual surgeons, makes it possible to define strategies for improving the use of wards. Going even deeper into this topic, each physician (surgeon and anesthesiologist) must have feedback on their actions, including delays, duration of interventions, costs associated with their procedures, and registration of complications. This will help evaluate and improve the physician's practice, undoubtedly improving ward efficiency [19].

Although it is not considered an efficiency parameter by itself, it is striking that the estimated number of daily surgeries per ward is around two. A retrospective study in a Chilean university hospital shows a three-year throughput of 2.5 surgeries a day per ward [20], equivalent to that of 2019. In contrast, the throughput reported in 2018, 2020, and 2021 was lower than that of the university hospital. Additionally, we observe that the number of reported surgeries per year was between 250 000 and 290 000 (except in 2019). The Ministry of Health reported that the waiting list as of March 2021 was 290 000 patients. This means that while waiting for surgery, there is at least one year of surgical activity [9].

Ward turnover is another marker of ward efficiency and is related to the surgeon's satisfaction with ward efficiency [21]. A turnover of fewer than 25 minutes is considered efficient and medium efficiency if it is less than 40 minutes [7]. From the data that could be extracted from the Department of Health Statistics and Information database, it was determined that ward preparation times range from 48 minutes (2020) to 72 minutes (2018). average is around two surgeries, implying one replacement per ward, so the time is excessive. However, it is unclear whether this includes the starting delay of the first ward, another efficiency parameter. In any case, there is evidence that the lower ward occupancy in public compared to private systems is determined by ward turnover, with no significant differences in the duration of the surgery [22]. Ward expenditure is another important indicator of efficiency. The work carried out by diagnosis-related groups in recent years has been crucial for this task, making it possible to search for strategies to obtain optimal and cost-effective clinical results in

different surgical subspecialties. The self-management policy of hospitals requires reliable budgets. This is key for health centers with fixed budgets, such as the public network in Chile [7].

Another indicator of ward efficiency is the percentage of cancelations; a ward with less than 5% is considered efficient. A study conducted in a pediatric-university hospital in our country showed a surgery cancelation rate of 4%, most of which was attributable to changes in the patient's health [23]. Whenever surgeries are canceled for any reason, efficiency is at risk, waiting time for the patient increases, quality of care is compromised, resources are wasted, and costs increase [24].

Cancelations are a problem worldwide. It has economic repercussions for the institution or health system and on the patient's prognosis. Smith et al. in 2014 reported that cardiac surgeries with a 2% suspension rate are associated with 5% mortality in the first 30 days [25]. Additionally, it is linked to anxiety due to rescheduling, additional health expenses, decreased perception of treatment quality, and decreased quality of life [24].

To address these problems, we must identify all preventable causes. This study reports high cancelation rates, many of which could have been prevented [26]. The major cause of cancelation identified was the "patient". However, when delving deeper into the problems attributable to this cause, it is observed that many could be solved with better management: acute or chronic conditions that contraindicate surgery, lack of fasting or preparation for surgery (e.g., intestinal), altered preoperative examinations or failure to suspend anticoagulation, lack of evaluation by another specialty or incomplete preoperative studies. A unit designed to manage this could reduce cancelations considerably or anticipate them and grant the appointment to people in conditions to have the surgery.

Secondly, there is the cause of the "surgical team", which accounts for the prolongation of the scheduled surgical times. This means that surgeries took longer than scheduled or that there was a shortage of personnel. This can be solved with better management of resources, avoiding underestimation of surgical times, and reducing ward turnover time.

"Administrative" causes are in third place. It is often impossible to anticipate equipment failures here, but correct maintenance is a potential solution. In this case of cancelation, we speculate that the availability of beds in critical and recovery units may be key. Again, prior patient assessment, proper preparation, and the use of shortened inpatient or outpatient circuit units may decrease these requirements [27–29].

Finally, but highly worrying, is the high "number of monthly suspensions per institution" due to union causes. This aspect should be addressed, considering the working conditions of healthcare personnel and the need to avoid canceling surgeries [30]. We estimate that there is underreporting given the low proportion of institutions that mention this cause and the high number of suspensions in those that do. This could be biased, for example, by prolongation of scheduled surgical times (surgical team). It is known that the National Federation of Health Workers (FENATS) systematically holds meetings during working hours in the morning, which the health workers attend with all their rights, returning after the meeting. This prevents surgeries from starting and the previously scheduled surgical work from being carried out. Consequently, even though the patients did not undergo surgery due to the prolongation of the scheduled surgical time, the real cause is union-related. The right to manifest and group together to improve working conditions is valid. However, the cancelation of wards is a threat to the health of people who have been waiting for long periods. Likewise, the "prolongation of surgical times" cause also hides other under-reported variables, such as the staff's delay (surgeon or anesthesiologist).

The analysis by region for 2021 shows that ward problems are not homogeneous. The regions of Tarapacá and Aysén need to increase the proportion of active pavilions. Consequently, the latter has the highest rate of cancelations due to infrastructure. Each center probably has its problems, so even though the Ministry of Health guidelines are necessary, each center should carry out interventions according to its circumstances.

The limitations of this study relate to the type and consistency of data routinely collected by the Department of Health Statistics and Information. This is valid for every health system in the world; it is reported that the instructions for collecting national statistics in England and Wales still contain anomalies and inconsistencies in the specification of data listing booked and deferred admissions and day cases [2]. Suppose we want to improve ward management. In that case, it is necessary to include in the monthly statistical summaries: the percentage of turnover times greater than one hour, the starting time of the first surgery, the percentage of wards that are extended beyond the scheduled time, the percentage of compliance with the scheduled surgical times, the percentage of schedules in relation to hired personnel and a better definition of cancelation causes, classifying them as preventable or non-preventable and a better breakdown of the "extended surgical times" section.

Finally, we strongly recommend that the quality department of each hospital be in charge of recording and managing this data, as this is currently done by the ward personnel themselves, who are both "judge and party" to the problem. This would lead to a true audit of ward operations. The efficient use of wards for elective surgeries is key to solving waiting lists. The phrase coined more than a century ago by William Thomson, "what is not defined cannot be measured, what is not measured cannot be improved, and what is not improved is always degraded," is more valid than ever [31].

Conclusions

All the studied parameters show that the use of wards in the Chilean Public Health System is inefficient and urgently requires better management to maximize the use of existing resources. It is necessary to increase the percentage of active and enabled wards, optimize the hours of use in relation to the contracted

time, improve ward turnover times and address the high rate of preventable cancelations.

On the other hand, the Department of Health Statistics and Information does not have all the parameters used in the literature to evaluate ward efficiency. Improving the design of registries would be useful for implementing more interventions.

Notes

Contributor roles

MB: conceptualization, methodology planning, data management, writing the original manuscript, and project management. MC: methodology planning, critical revision of the manuscript. MB: critical revision of the manuscript, editing, and project management. CB: validation, research, critical review of the manuscript. CI: validation, research, critical review of the manuscript, and project supervision. AM: validation, research, critical revision of the manuscript, and project supervision.

Acknowledgments

The first and third authors extend their gratitude for the continued support of Leonel Barahona in the development of clinical research.

Competing interests

All authors declare no conflicts of interest.

Funding

This study did not receive funding from any institution.

Ethics

The ethics committee of our institution determined that its approval was not necessary since the work only uses open-access data.

Data sharing statement

The databases used in this study are open-access and can be downloaded from https://deis.minsal.cl/#datosabiertos.

Provenance and peer review

Not commissioned. Externally peer-reviewed by five reviewers, double-blind.

Language of submission

Spanish.

References

1. Amoko DH, Modrow RE, Tan JK. Surgical waiting lists I: Definition, desired characteristics and uses. Healthc Manage Forum. 1992;5: 17–22. https://doi.org/10.1016/S0840-4704(10)61201-X
2. Iacobucci G. Waiting list for elective surgery tops four million for first time since 2007. BMJ. 2017;358. https://doi.org/10.1136/bmj.j3861
3. MdSd C. Lista de espera no GES y Garantias de oportunidad GES retrasadas. 2021.
4. Barahona M, Barrientos C, Escobar F, Diaz N, Palma D, Barahona MA, et al. Trends in Knee and Hip Arthroplasty in Chile Between 2004 and 2019. Cureus. 2020;12. https://doi.org/10.7759/cureus.12185
5. Rathnayake D, Clarke M, Jayasinghe V. Patient prioritisation methods to shorten waiting times for elective surgery: A systematic review of how to improve access to surgery. PLoS One. 2021;16. https://doi.org/10.1371/journal.pone.0256578
6. Estay R, Cuadrado C, Crispi F, González F, Alvarado F, Cabrera N. Desde el conflicto de listas de espera, hacia el fortalecimiento de los prestadores públicos de salud: Una propuesta para Chile. Cuadernos Médico Sociales. 2017;57.
7. Macario A. Are your hospital operating rooms "efficient"? A scoring system with eight performance indicators. Anesthesiology. 2006;105: 237–40. https://doi.org/10.1097/00000542-200608000-00004
8. Pandit JJ, Westbury S, Pandit M. The concept of surgical operating list "efficiency": a formula to describe the term. Anaesthesia. 2007;62: 895–903. https://doi.org/10.1111/j.1365-2044.2007.05174.x
9. Chile, Ministerio de Salud. Manual series REM. 2021.
10. Bachelet VC. Integrando el mejoramiento de la calidad con la salud pública. Medwave. 2014;14: 03. https://doi.org/10.5867/medwave.2014.03.5935
11. Bachelet VC, Goyenechea M, Carrasco VA. Policy strategies to reduce waiting times for elective surgery: A scoping review and evidence synthesis. Int J Health Plann Manage. 2019;34: e995–e1015. https://doi.org/10.1002/hpm.2751
12. Barahona M, Martínez Á, Barahona M, Ramírez M, Barrientos C, Infante C. Impact of COVID-19 outbreak in knee arthroplasty in Chile: a cross-sectional, national registry-based analysis. Medwave. 2022;22. https://doi.org/10.5867/medwave.2022.04.002511
13. Dickenson EJ, Jordan RW, Poole C, Shyamalan G, Arbuthnot J, Makrides P, et al. Is it safe to perform elective orthopaedic surgery with high community rates of COVID-19? An observational cohort study. Ann R Coll Surg Engl. 2021;103: 415–419. https://doi.org/10.1308/rcsann.2020.7141
14. Jabbal M, Campbel N, Savaridas T, Raza A. Careful return to elective orthopaedic surgery in an acute hospital during the COVID-19 pandemic shows no increase in morbidity or mortality. Bone Jt Open. 2021;2: 940–944. https://doi.org/10.1302/2633-1462.211.BJO-2021-0114.R1
15. Sharma D, Agrawal V, Agarwal P. Roadmap for Restarting Elective Surgery During/After COVID-19 Pandemic. Indian J Surg. 2020;82: 235–239. https://doi.org/10.1007/s12262-020-02450-1
16. Vega-Gómez KP, Esteves-Fajardo ZI, Luján-Johnson GL, Quito-Esteves AC. Impactos psicológicos del COVID-19 en el desempeño laboral en trabajadores de establecimientos de salud. CM. 2022;8: 546–557. www.cienciamatriarevista.org.ve/index.php/cm/issue/view/24 https://doi.org/10.35381/cm.v8i3.786
17. Charlesworth M, Pandit JJ. Rational performance metrics for operating theatres, principles of efficiency, and how to achieve it. Br J Surg. 2020;107: e63–e69. https://doi.org/10.1002/bjs.11396
18. Pradenas Rojas L, Matamala Vergara E. Una formulación matemática y de solución para programar cirugías con restricciones de recursos humanos en el hospital público. Ingeniare Rev chil ing. 2012;20: 230–241. https://doi.org/10.4067/S0718-33052012000200010

19. Winegar AL, Jackson LW, Sambare TD, Liu TC, Banks SR, Erlinger TP, et al. A Surgeon Scorecard Is Associated with Improved Value in Elective Primary Hip and Knee Arthroplasty. J Bone Joint Surg Am. 2019;101: 152–159. https://doi.org/10.2106/JBJS.17.01553
20. Austin TM, Lam HV, Shin NS, Daily BJ, Dunn PF, Sandberg WS. Elective change of surgeon during the OR day has an operationally negligible impact on turnover time. J Clin Anesth. 2014;26: 343–9. https://doi.org/10.1016/j.jclinane.2014.02.008
21. Cerfolio RJ, Ferrari-Light D, Ren-Fielding C, Fielding G, Perry N, Rabinovich A, et al. Improving Operating Room Turnover Time in a New York City Academic Hospital via Lean. Ann Thorac Surg. 2019;107: 1011–1016. https://doi.org/10.1016/j.athoracsur.2018.11.071
22. Cowley RJ, Frampton C, Young SW. Operating time for total knee arthroplasty in public versus private sectors: where does the efficiency lie? ANZ J Surg. 2019;89: 53–56. https://doi.org/10.1111/ans.14905
23. Pattillo S. JC, Dexter F. Enfrentando el dilema de las suspensiones: características e incidencia de las suspensiones quirúrgicas en un centro académico en Chile. Rev Chil Cir. 2018;70: 322–328. https://doi.org/10.4067/s0718-40262018000300322
24. Al Talalwah N, McIltrot KH. Cancellation of Surgeries: Integrative Review. J Perianesth Nurs. 2019;34: 86–96. https://doi.org/10.1016/j.jopan.2017.09.012
25. Smith MM, Mauermann WJ, Cook DJ, Hyder JA, Dearani JA, Barbara DW. Same-day cancellation of cardiac surgery: a retrospective review at a large academic tertiary referral center. J Thorac Cardiovasc Surg. 2014;148: 721–5. https://doi.org/10.1016/j.jtcvs.2014.03.002
26. Koh WX, Phelan R, Hopman WM, Engen D. Cancellation of elective surgery: rates, reasons and effect on patient satisfaction. Can J Surg. 2021;64: E155–E161. https://doi.org/10.1503/cjs.008119
27. Hartog Y den, Mathijssen NMC, Vehmeijer SBW. Total hip arthroplasty in an outpatient setting in 27 selected patients. Acta Orthop. 2015;86: 667–70. https://doi.org/10.3109/17453674.2015.1066211
28. Kort NP, Bemelmans YFL, van der Kuy PHM, Jansen J, Schotanus MGM. Patient selection criteria for outpatient joint arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2017;25: 2668–2675. https://doi.org/10.1007/s00167-016-4140-z
29. Ng VY, Lustenberger D, Hoang K, Urchek R, Beal M, Calhoun JH, et al. Preoperative risk stratification and risk reduction for total joint reconstruction: AAOS exhibit selection. J Bone Joint Surg Am. 2013;95: e191–15. https://doi.org/10.2106/JBJS.L.00603
30. Bachelet VC. Una revisión crítica de tres dimensiones de concesiones en salud: riesgo, calidad y efectos fiscales. Medwave. 2010;10. https://doi.org/10.5867/medwave.2010.09.4780
31. Houser KW. To Measure Is to Know… or Not. Taylor & Francis; 2022. https://doi.org/10.1080/15502724.2022.2029086

Estimación de la eficiencia del uso de pabellones electivos en el sistema de salud público chileno entre 2018 y 2021

Resumen

Objetivo

El uso eficiente de pabellones destinados a cirugías electivas es fundamental para resolver patologías en lista de espera quirúrgica. El objetivo general de este estudio es estimar la eficiencia del uso de pabellones en el sistema de salud público de Chile entre los años 2018 y 2021.

Métodos

El diseño fue un estudio ecológico. Se analizó la Sección A.21 de la base de datos construida por los resúmenes estadísticos mensuales que cada establecimiento de la red de salud pública reportó al Ministerio de Salud de Chile entre 2018 y 2021. Se extrajeron los datos de la subsección A, E y F: dotación de pabellones, total de cirugías electivas por especialidad, número y causas de suspensión de cirugías electivas. Luego se estimó el rendimiento quirúrgico en horario hábil y el porcentaje de ocupación horaria respecto de una jornada laboral. Adicionalmente, se hizo un análisis por región con datos de 2021.

Resultados

El porcentaje de pabellones electivos respecto de los en dotación varió entre 81,1 y 94,1%; mientras que los habilitados respecto de los en dotación varió entre 70,5 y 90,4% durante 2018 y 2021. El número total de cirugías fue más alto en 2019 (n = 416 339), pero en 2018, 2020 y 2021 variaron entre 259 y 297 mil cirugías. Las suspensiones varían entre 10,8 (2019) y 6,9% (2021), siendo la principal causa de suspensión atribuida al "paciente". Al analizar la cantidad de pacientes suspendidos mensualmente por institución, se observa que la principal causa es "gremial". El rendimiento máximo de un pabellón destinado a cirugía electiva se alcanzó en 2019 y fue de 2,5 cirugías; mientras que en 2018, 2020 y 2021 el rendimiento bordea las dos cirugías por pabellón habilitado para cirugía electiva. El porcentaje de tiempo de pabellón ocupado en horario hábil respecto a una jornada de contrato varía entre 80,7 (2018) y 56,8% (2020).

Conclusiones

Todos los parámetros encontrados y estimados en este estudio muestran que el uso de pabellones en el sistema público de Chile es ineficiente.