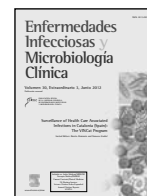




# Enfermedades Infecciosas y Microbiología Clínica

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## Surveillance of surgical site infections in elective colorectal surgery. Results of the VINCat Program (2007-2010)

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### ABSTRACT

#### Keywords:

VINCat  
Surveillance programs  
Surgical site infections  
Colon surgery

The VINCat Program is a standardized surveillance program of healthcare infections in Catalonia, Spain. This program includes monitoring of surgical site infections (SSI) of elective colorectal surgery. The aim of this study was to define SSI rates in colorectal surgery among VINCat hospitals over a period of 4 years. We included consecutive elective colorectal interventions performed in VINCat hospitals from 2007 to 2010. Follow-up visits were performed 30 days after surgery. Prospective monitoring of SSI in colorectal surgery was performed according to standardized VINCat methodology. SSI was defined according to the Centers for Disease Control (CDC) and surgical risk factors according to the National Healthcare Safety Network (NHSN) classification.

From 2007 to 2010, 49 centers performed 10,104 surgical procedures. The cumulative incidence of SSI was 20.8% (95% CI: 20.03-21.63). The annual cumulative SSI incidence rate did not vary significantly over the study period; however, there were significant differences among hospital infection rates. The relative frequency of organ-space infection increased from 25% in 2007 to 40% in 2010 ( $p < 0.001$ ). Laparoscopic surgery also increased (28% in 2007 to 42% in 2010,  $p < 0.001$ ). However, no changes were observed in mean surgery duration, ASA score and degree of surgical contamination.

The VINCat Program incorporated a large number of Catalan hospitals that participated in standardized monitoring of colorectal surgery. The cumulative incidence rate of SSI for colorectal surgery was 20.8%, although there were large variations between hospitals.

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## Monitorización de la infección de localización quirúrgica en cirugía colorrectal electiva. Resultados del Programa VINCat (2007-2010)

### RESUMEN

#### Palabras clave:

VINCat  
Vigilancia  
Infección  
Localización quirúrgica  
Cirugía de colon

El VINCat es un programa estandarizado de vigilancia de las infecciones nosocomiales en Cataluña, España. Este programa incluye la monitorización de la infección de localización quirúrgica (ILQ) en la cirugía de colon. El objetivo de este estudio ha sido establecer las tasas de ILQ en cirugía colorrectal en los hospitales del Programa VINCat en un período de 4 años.

Se han incluido las intervenciones electivas en cirugía colorrectal practicadas en los hospitales del VINCat desde 2007 a 2010, con un seguimiento de 30 días desde la intervención. La vigilancia de la ILQ se realizó de acuerdo a la metodología estandarizada del programa. Se definió ILQ de acuerdo a los criterios de los Centers for Disease Control (CDC) y el riesgo quirúrgico de acuerdo a la clasificación del National Healthcare Safety Network (NHSN).

Durante el período 2007-2010, 49 hospitales incluyeron 10.104 procedimientos quirúrgicos. La incidencia acumulada de ILQ fue del 20,8% (IC del 95%, 20,03-21,63). La incidencia anual no varió significativamente a lo largo del período de estudio; sin embargo, se observaron diferencias muy marcadas en las tasas de infec-

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ción entre hospitales. La frecuencia relativa de infección de órgano o espacio se incrementó desde el 25% en 2007 hasta el 40% en 2010 ( $p < 0,001$ ). La cirugía laparoscópica también se incrementó (del 28% en 2007 al 42% en 2010;  $p < 0,001$ ). Sin embargo, no se observaron cambios en la duración media de la cirugía, la clasificación ASA y el grado de contaminación de la cirugía.

El Programa VINCat incorpora un elevado número de hospitales de Cataluña que participan en la vigilancia estandarizada de la cirugía colorrectal. La incidencia acumulada de ILQ en cirugía colorrectal fue del 20,8%, aunque se observaron amplias variaciones entre hospitales.

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## Introduction

Surgical site infection (SSI) is the most common postoperative complication and is the leading cause of nosocomial infection in many centers.<sup>1</sup> Colorectal surgery infection significantly increases morbidity and mortality, which results in longer hospital stays and greater patient, hospital and healthcare system costs.<sup>2,3</sup> To reduce the incidence of these complications, there has been a significant development of quality programs and surveillance systems such as the VINCat Program.<sup>4</sup> The objective of this program is the surveillance, prevention and reduction of nosocomial infections in the Catalan hospital network, through the monitoring of various indicators. SSI surveillance covers most major surgical procedures performed in hospitals, both in their frequency and healthcare system impact.<sup>5</sup> Elective colorectal surgery is a frequent surgical procedure practiced in most hospitals that has a high infection risk due the clean-contaminated nature of the surgery. The aim of this study is to report SSI rates for elective colorectal surgery in hospitals participating in the VINCat Program over a four-year period.

## Material and Methods

### Study period and participating centers

Forty-nine of the 66 hospitals participating in the VINCat Program were included in the analysis. Prospective surveillance was performed by the infection control team (ECI) of each hospital to ensure appropriate data collection. Hospitals were stratified into 3 groups based on size: Group 1, more than 500 beds (8 centers); Group 2, 200-500 beds (16 centers) and Group 3, less than 200 beds (25 centers). The surveillance period lasted from January 2007 to December 2010.

### Surveillance

The methodology used in the surveillance of SSIs is described in the VINcat Program manual<sup>6</sup> and is similar to other international reference programs, such as the National Healthcare Safety Network

(NHSN)<sup>6,7</sup>. Monitoring of colorectal surgery was performed prospectively and continued until a minimum of 100 interventions per year were monitored or continuously throughout the year if the center did not reach this figure. Hospitals with less than 10 interventions per year were excluded. Table 1 shows the inclusion and exclusion criteria for colorectal surgery. Surveillance was mandatory for a period of 30 days after surgery. Monitoring during hospitalization and post-discharge was performed with a standardized methodology (Table 2).

### Definitions

SSI was defined according to the Centers for Disease Control (CDC)<sup>8</sup> and was stratified into categories of surgical procedures (-1 to 3) according to the risk of surgical infection defined by the NHSN.<sup>8</sup>

## Results

During the period 2007-2010, SSI surveillance was performed on 10,104 elective colorectal procedures from 49 centers. The cumulative incidence of SSI was 20.8% (95% CI: 20.03-21.63). The general characteristics of the population and the annual incidence of SSI during the study period are described in Table 3. There was a higher participation of hospitals throughout the study period and, consequently, a larger number of procedures per year were included. There were no significant differences in terms of age, sex, appropriate surgical prophylaxis and average length of intervention; however, there was a trend towards increased ASA score  $>1$  from 36% in 2007 to 39% in 2010 and in the percentage of laparoscopic surgeries from 28% to 42%, respectively. Due to the increase in laparoscopic surgery, there was a decrease in the National Nosocomial Infection Surveillance (NNIS) risk index, although this decrease did not involve significant changes in the annual rates of SSI, which were approximately 21%. Table 4 shows the SSI rates distributed by percentile and adjusted by NNIS risk index. Table 5 displays SSI rates by hospital group. SSI rates

**Table 1**

Inclusion and exclusion criteria for colorectal surgery surveillance in the VINCat Program

Inclusion criteria
Colon or rectal elective surgery
Minimum of 100 procedures per year per hospital or continuous monitoring throughout the year for those centers that perform less than 100 procedures per year
Exclusion criteria
Peritonitis at the time of intervention (we excluded patients who underwent "dirty" surgery)
Patients who underwent multiple procedures during the same surgery, for example resection of liver metastases
Centers that performed less than 10 surgical procedures annually
Centers that have not been able to ensure prospective surveillance during hospitalization or effective monitoring of cases within 30 days of the intervention

**Table 2**

Methodology of colorectal surgery monitoring in the VINCat Program

During hospitalization
From the day of surgery until hospital discharge: active monitoring of surgical site infection signs by a periodic visit (every 2-3 days) and review of the following items:
• Nursing clinical courses/oral information provided to doctors and nurses
• Temperature chart of patient
• Antibiotic treatments
• Washing of surgical wound
• Review of microbiology cultures and complementary radiological examinations
Post-discharge surveillance
Comprises a period of 30 days from the intervention. The post-discharge follow-up includes:
• Control of readmissions (Required)
• Control of the consultations at the Emergency Department (Required)
• Review of outpatient clinical course of the surgical team (Required)
• Review of the radiological procedures and microbiological cultures (Required)
• Phone control (Optional)

**Table 3**

Colorectal surgery characteristics and surgical site infections annual rates of the VINCAt Program (2007-2010)

	2007 37 centers	2008 43 centers	2009 44 centers	2010 49 centers	Overall
Number of surgeries	2.090	2.533	2.772	2.709	10.104
Age, years (SD)	69 (12)	69 (12)	69 (12)	69 (12)	69 (12)
Sex, male/female (%)	59/41	58/42	60/40	58/42	59/41
Adequate surgical prophylaxis (%)	91	93	93	92	93
Mean duration of intervention, minutes (SD)	170 (84)	171 (72)	168 (74)	172 (71)	170 (75)
ASA score >1 (%)	36	37	36	39	37
Laparoscopy (%)	28	31	39	42.5	36
NNISS $\geq 1$ (%)	52	47	42	42	45
SSI (%)	21.4	19.2	21.4	21.4	20.8
SSI superficial incisional (%)	51	42	43	42	44
SSI deep incisional (%)	24	22	15	18	19
Organ/space (%)	25	36	42	40	37

ASA: physical status classification score; NNISS: National Nosocomial Infection Surveillance System risk index; SD: standard deviation; SSI: surgical site infection.

**Table 4**

Cumulative average and surgical site infections rate distribution by percentile in colorectal surgery

NNISS score	No. hospitals	No. surgeries	No.infections	Mean SSI (%)	Percentile				
					10%	25%	50% (median)	75%	90%
-1	47	1086	132	12.2	0.0	0.0	9.6	20.0	33.3
0	49	4385	794	18.1	8.9	12.8	19.0	23.2	31.0
1	49	3638	869	23.9	10.5	15.9	24.1	31.1	36.0
2	49	913	298	32.6	14.3	22.9	33.3	41.4	57.9

NNIS: National Nosocomial Infection Surveillance System risk index; SSI: surgical site infection.

**Table 5**

Average and percentiles of surgical site infections in colorectal surgery (overall and by hospital groups)

	Overall VINCAt Program	Group 1 >500 beds	Group 2 200-500 beds	Group 3 <200 beds
No. centers	49	8	16	25
No. surgeries	10104	3317	3887	2900
Mean SSI (SD)	21% (6.9)	22.4% (4.6)	20.5% (7.6)	20.8% (7.3)
Percentiles				
10	10.8	15.6	9.6	11.3
25	15.3	19.2	13.3	14.1
50 (median)	21	21.5	21.3	21
75	25.8	27.3	26.3	25.8
90	31.5	29.1	32.4	32.4

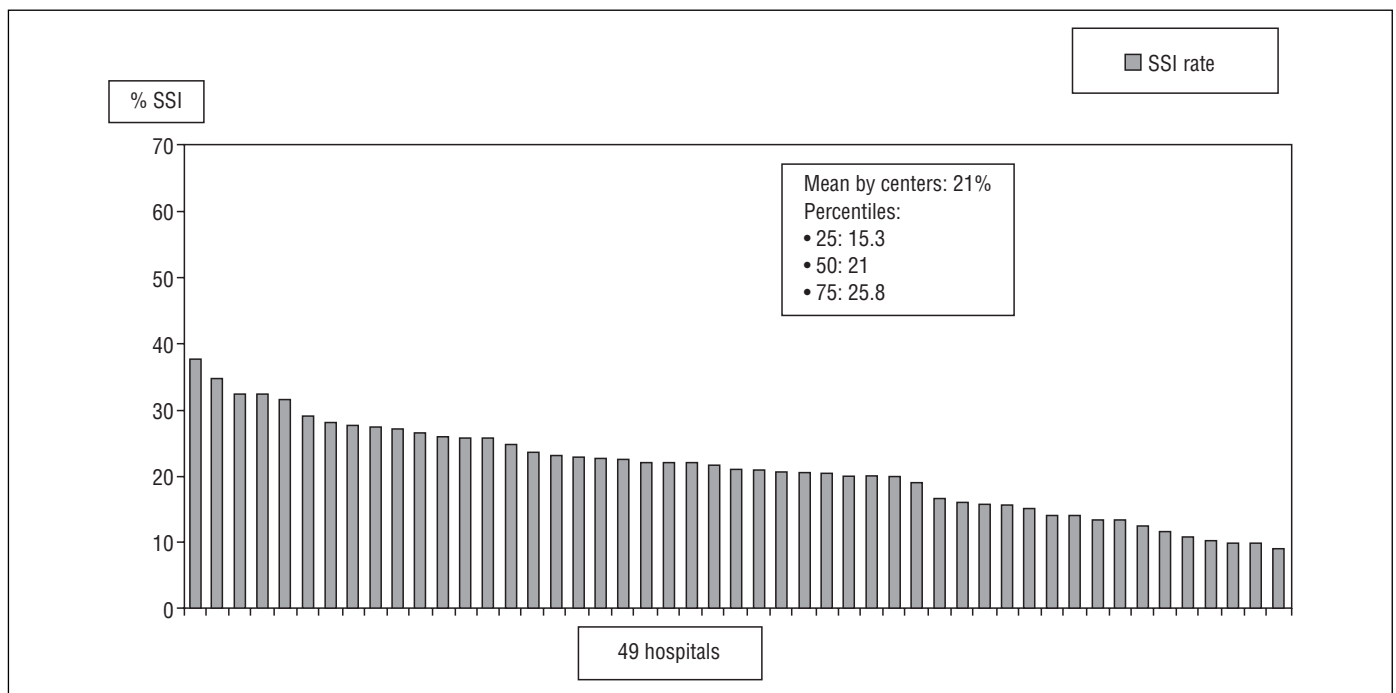
SSI: surgical site infection; SD: standard deviation.

were slightly higher in Group 1 hospitals (>500 beds), although the variability of SSI rates in all 49 hospitals (Fig. 1) and within hospital groups (Fig. 2) was large. However, cumulative annual rates by NNISS risk index were similar throughout the study period (Fig. 3).

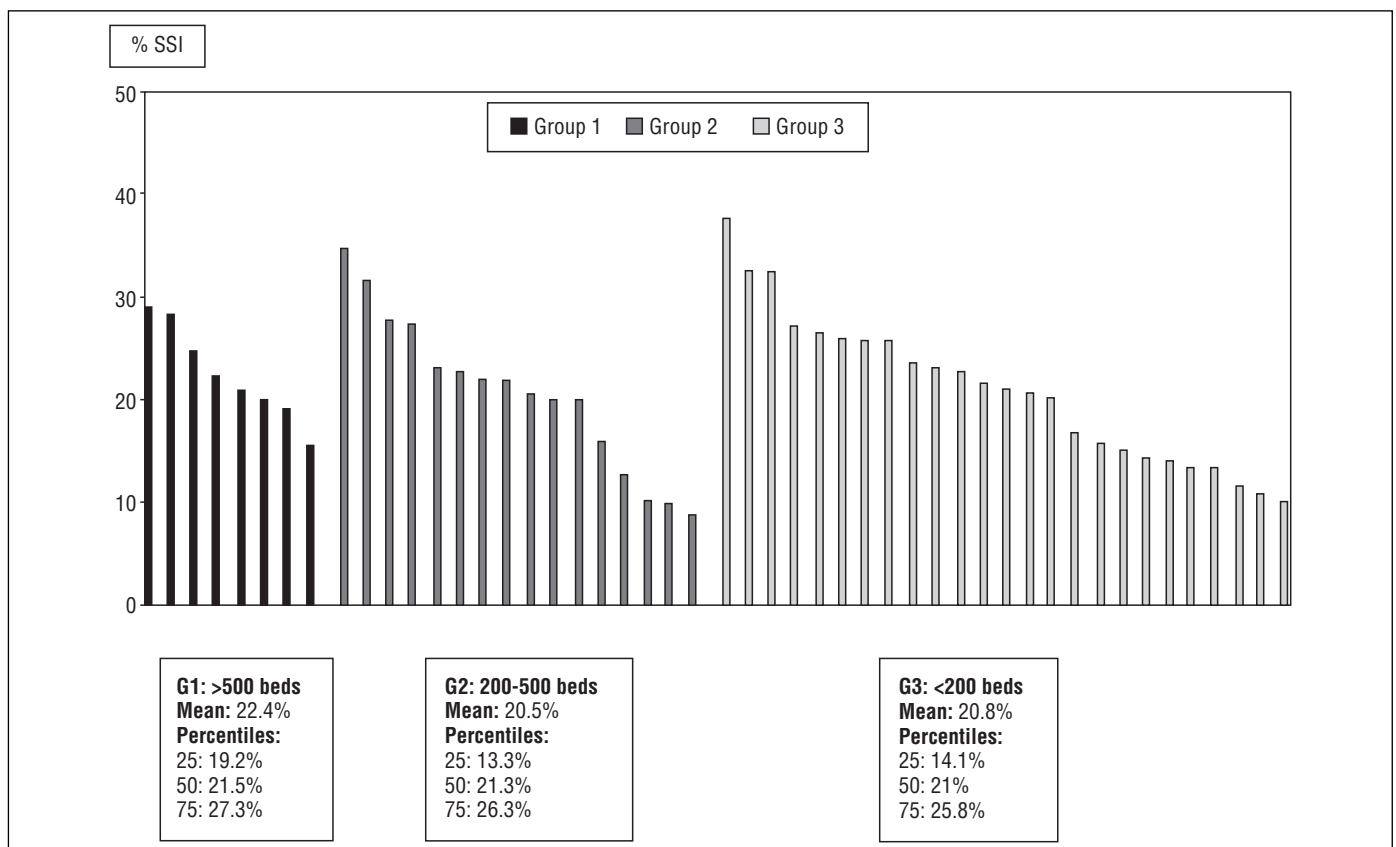
## Discussion

This paper presents the results of 4 years' worth of surveillance of elective colorectal surgery infection performed by the VINCAt Program. Most Catalan hospitals participated in the VINCAt Program, and there were notable differences in complexity, size and funding among the hospitals.<sup>4</sup> Patients who were included in this study were

therefore representative of current surgical colorectal programs practiced in Catalan hospitals. The minor variations observed over the study period, especially in patient characteristics, reinforce the strength of the data. The variations also reveal the effort exerted by program managers to ensure a high level of training of infection control teams dedicated to monitoring surgery infections, as well as the efforts of the infection control teams to follow surveillance guidelines according to the standards of the VINCAt Program.<sup>9</sup> Standardization of routine surveillance, following the NHNS methodology with high specificity of the inclusion / exclusion criteria and mandatory post-discharge follow up, has contributed to homogeneous annual results that have a high level of consistency.<sup>10</sup>



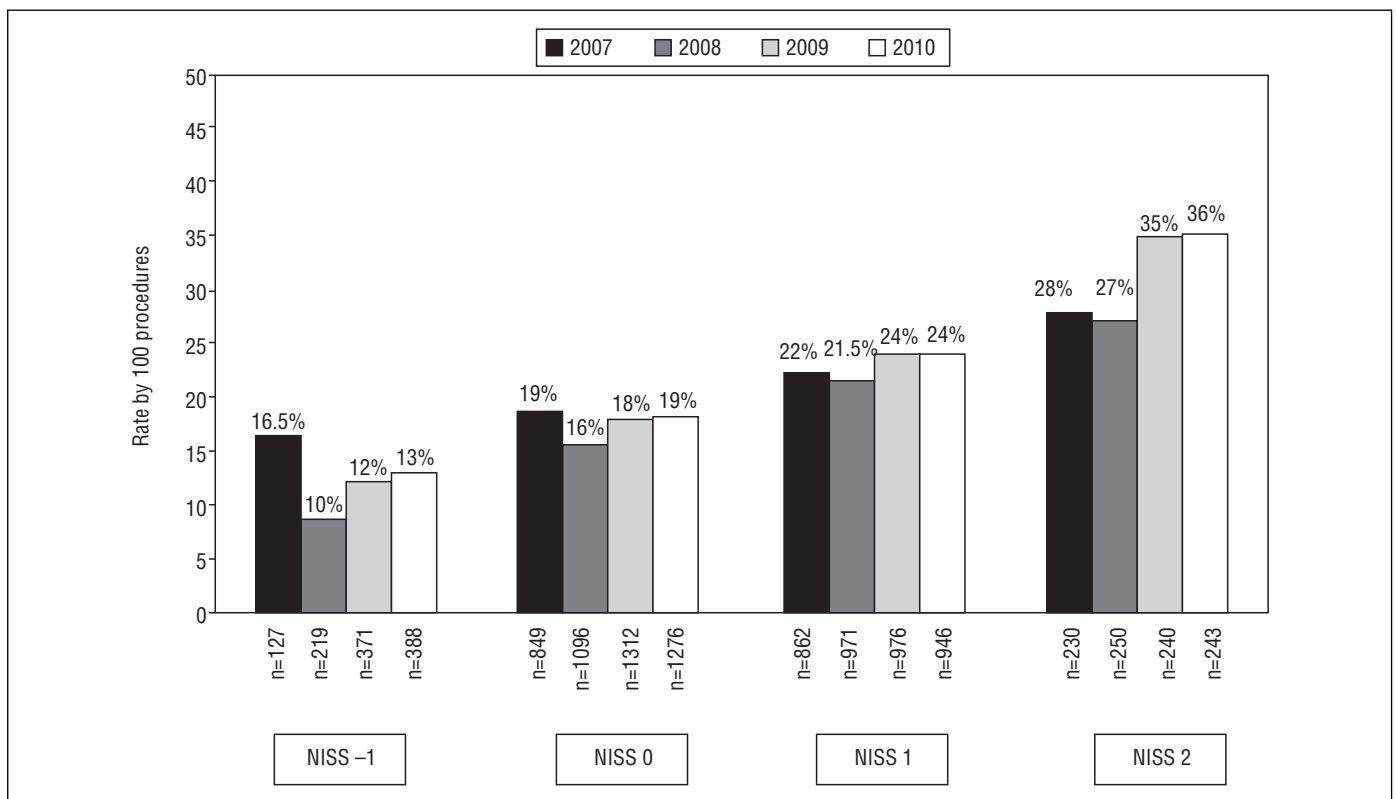
**Figure 1.** SSI rates in elective colorectal surgery (2007-2010).



**Figure 2.** SSI rates in elective colorectal surgery by type of hospital (2007-2010).

There are some important aspects worth highlighting in our results. The colorectal surgery infection rate in our study was significantly higher than rates reported by other surveillance programs with similar characteristics, which is all the more interesting considering that the VINCat Program includes only scheduled clean-contaminated elective surgery procedures.<sup>11</sup>

However, our annual SSI rates over the study period were very similar, which suggests that the situation in Spain is different from that of other countries. Although it is difficult to explain this discrepancy with other European programs, the monitoring methodology used in the VINCat Program, which includes systematic patient monitoring during admission and discharge, may favor a



**Figure 3.** SSI annual rates in colorectal elective surgery by NISS risk score (2007-2010).

higher SSI incidence rate compare to other programs that do not perform strict post-discharge surveillance. It is important to note that, up to now, most surgical surveillance programs did not include post-discharge surveillance in the calculation of infection rates. Reported infection rates that occur after discharge, which can vary according to the type of surgical procedure, can reach up to 30% of total infection cases.<sup>13</sup> Moreover, our SSI rate is similar to that reported by a multicenter study in the same environment.<sup>12</sup> Some studies have suggested that monitoring of surgical infections significantly reduces infection rates.<sup>14</sup> It is clear that information on surgical infection rates and comparisons with similar centers stimulates the introduction of prevention measures.<sup>15</sup> However, SSI rates in elective colon surgery from our program did not improve over the long study period and therefore do not support this hypothesis. Nevertheless, is important to note that although the directors of the program have not implemented any specific preventive interventions for reducing surgical infection rates, the hospitals are likely taking preventive actions whose effects should be evident soon. The consistently high surgical infection rates over the years suggest that, in addition to monitoring and periodic delivery of information to surgical teams, specific preventive measures need to be implemented. This is no easy task, however, because measures that reduce infection rates in one center may not be applicable in another. The recently published implementation of a set of measures for preventing SSI in colorectal surgery has not had a significant impact on infection rates.<sup>12,16,17</sup> There is an urgent need, therefore, to determine our surgical infection rates and establish effective measures in our environment that contribute to a significant reduction of SSI.

One of the most striking results of this study, which is rarely discussed in the literature, is the remarkable variation in SSI rates among hospitals, even when stratified by groups with similar characteristics (Figs. 1 and 2). As shown in Figure 1, the cumulative incidence rates of SSI in colon surgery can vary by almost 30 points.

Centers with SSI above the 75% percentile can be considered to have serious problems with colorectal surgery infection, while hospitals with rates below 25% percentile may have a surveillance problem in their failure to properly detect surgical infections.

Colorectal surgery has been regarded as a single procedure. However, it is now well established that colon surgery rates are lower than those for rectal procedures.<sup>18</sup> Since 2011, the VINCat Program has collected colon and rectal surgery procedures clearly differentiated.

Another interesting aspect of this study was the correlation between the NNIS risk index and infection rates. In our experience, this correlation has been very strong and therefore this index is still a good predictor of SSI risk.<sup>19</sup>

In colorectal surgery, organ/space infections need to be differentiated from incisional infections since the organ/space impact on morbidity, mortality and the use of health resources is much higher.<sup>20</sup> This differentiation can help significantly in avoiding the bias caused by the inclusion (or not) of mild superficial incisional infections, which are sometimes detected after discharge. In order to compare SSI rates between institutions and hospital groups, organ/space infections should be considered separately from incisional infections. In addition, organ/space colorectal infection depends on both the host characteristics and the surgical technique, and all possible options should be considered in order to reduce the incidence of serious infections.<sup>21,22</sup>

In summary, detailed knowledge of infection rates in colorectal procedures may help us implement strategies for preventing and reducing the incidence of this important complication.

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## Conflicts of Interest

All authors declare that they have no conflicts of interest in this article.

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