

Use of the substitution index to identify improvement opportunities in major ambulatory surgery[☆]

José E. Calle^{a,*}, Pedro Parra^a, Rafael Gomis^a,
Teresa Ramón^a, Fernando San Eustaquio^b

^a Health Authority, Quality in Health Care Subdepartment, Region of Murcia, Spain

^b Reina Sofía General Hospital, Clinical Documentation Section, Region of Murcia, Spain

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Abstract

Major ambulatory surgery (MAS) is an alternative to traditional hospitalization. Its goals are to reduce cost while increasing patient safety and satisfaction. The substitution index of MAS has been used to identify those surgical procedures, which present the largest impact in avoidable stays. There is a wide margin for improvement in relation to the performance of MAS. Five DRG's account for more than 50% of the avoidable stays. To promote MAS, it would be necessary to introduce changes in financing and incentive policies, include new procedures, review clinical guidelines and establish benchmarking strategies.

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1. Introduction

The term major ambulatory surgery (MAS) is used to refer to surgical cases performed under general, regional or local anaesthesia or sedation that require low intensity short term post-operative care and allow the patient to return home a few hours after surgery with no need for hospitalization. As an alternative to the traditional approach, it can be used to reduce both costs and waiting lists and increase the efficiency and quality of patient care in order to achieve a high level of patient satisfaction and safety. MAS has become a paradigm for the changes taking place in the healthcare system as a whole [1].

The substitution index (SI) is a very important indicator for monitoring the quality of surgical activity at the hospital level,

because it is not possible to use the usual clinical indicators (average pre- and post-operative stays, hospital infections, surgical mortality, etc.) when discussing MAS.

For several years, public hospitals in the Region of Murcia have kept records of specialized ambulatory care cases in order to determine how many MAS interventions were performed in each of them. Other regions in Spain use the same approach and can provide data on this type of care.

For these reasons we decided to undertake the task of calculating the SI for each hospital and for each diagnosis related group (DRG), determining the number of potentially avoidable admissions and stays, and identifying the DRG's which offer the best opportunities for improvement.

2. Methods and materials

We analyzed MBDS databases of specialized ambulatory care and hospitalization for the years 2002 and 2003 in six of the nine public hospitals in the Region of Murcia. As regards the remaining three hospitals, two of them kept no record of this type of care and the other one had not yet instituted out-

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* Corresponding author. Consejería de Sanidad, Hospital General Universitario Reina Sofía, Subdirección General de Calidad Asistencial, 7^a Planta, 30003 Murcia, Spain. Tel.: +34 968 35 97 64; fax: +34 968 35 97 77.

E-mail address: josee.calle@carm.es (J.E. Calle).

Table 1
Percentage of cases excluded by DRG

DRG	Emergency admissions	Length of stay > 14 days	Mental deficiency, psychiatric diseases or drug-addictions	Total excluded ^a	Excluded/total ^b (%)
6. Carpal tunnel release	22	–	–	22	29.73
36. Retinal procedures	74	8	–	76	26.67
38. Primary iris procedures	3	–	–	3	–
39. Lens procedures with or without vitrectomy	71	–	3	74	24.67
40. Extraocular procedures except orbit, age >17 years	40	2	1	40	41.67
41. Extraocular procedures except orbit, age <18 years	22	–	–	22	–
42. Intraocular procedures except retina, iris and lens	80	19	1	85	31.14
55. Miscellaneous ear, nose, mouth and throat procedures	52	1	13	66	8.20
59. Tonsillectomy and/or adenoidectomy only, age >17 years	4	–	1	5	8.62
60. Tonsillectomy and/or adenoidectomy only, age <18 years	17	1	–	17	6.80
119. Vein ligation and stripping	16	–	–	16	5.52
158. Anal and stomal procedures without CC	516	15	4	526	61.38
160. Hernia procedures except inguinal and femoral, age >17 without CC	164	11	4	170	26.28
162. Inguinal and femoral hernia procedures, age >17 years without CC	292	9	12	304	26.07
163. Hernia procedures, age <18 years	44	–	1	45	31.03
225. Foot procedures	102	11	4	104	25.81
227. Soft tissue procedures without CC	109	5	2	110	39.57
229. Hand or wrist procedures, except major joint procedure, without CC	219	2	1	219	65.96
231. Local excision and removal of internal fix devices except hip and femur	100	39	8	116	26.91
232. Arthroscopy	13	4	–	14	18.42
262. Breast biopsy and local excision for non-malignancy	30	1	1	32	31.68
267. Perianal and pilonidal procedures	81	1	3	84	28.47
339. Testes procedures, non-malignancy age >17 years	19	3	2	20	9.17
340. Testes procedures, non-malignancy age <18 years	23	–	–	23	12.85
342. Circumcision, age >17 years	9	–	–	9	–
343. Circumcision, age <18 years	9	–	–	9	22.50
351. Sterilization, male	2	–	–	2	–
361. Laparoscopy and incisional tubal interruption	26	–	1	27	34.18
362. Endoscopic tubal interruption	6	–	1	6	–
364. Dilation and curettage, conization except for malignancy	621	2	2	621	87.71
494. Laparoscopic cholecystectomy without CC	288	38	10	296	27.26
Total	3074	172	75	3163	33.12

Region of Murcia 2002–2003. DRG: diagnosis related group; CC: complication-comorbidity.

^a The total could be higher than the sum of parts given that some episodes can have more than one exclusion criteria simultaneously.

^b The percentage has been calculated, only for those DRG's with more than 30 cases in the hospitalization minimum basic data set.

Table 2
Number of procedures performed and SI by DRG

DRG	MAS	In-patient	Total	SI
6. Carpal tunnel release	854	52	906	94.26
36. Retinal procedures	137	209	346	39.60
38. Primary iris procedures	30	3	33	90.91
39. Lens procedures with or without vitrectomy	8565	226	8791	97.43
40. Extraocular procedures except orbit, age >17 years	1107	56	1163	95.18
41. Extraocular procedures except orbit, age <18 years	275	21	296	92.91
42. Intraocular procedures except retina, iris and lens	424	188	612	69.28
55. Miscellaneous ear, nose, mouth and throat procedures	677	739	1416	47.81
59. Tonsillectomy and/or adenoidectomy only, age >17 years	50	53	103	48.54
60. Tonsillectomy and/or adenoidectomy only, age <18 years	778	233	1011	76.95
119. Vein ligation and stripping	238	274	512	46.48
158. Anal and stomal procedures without CC	465	331	796	58.42
160. Hernia procedures except inguinal and femoral, age >17 years without CC	335	477	812	41.26
162. Inguinal and femoral hernia procedures, age >17 years without CC	743	862	1605	46.29
163. Hernia procedures, age <18 years	121	100	221	54.75
225. Foot procedures	562	299	861	65.27
227. Soft tissue procedures without CC	216	168	384	56.25
229. Hand or wrist procedures, except major joint procedure, without CC	503	113	616	81.66
231. Local excision and removal of internal fix devices except hip and femur	341	315	656	51.98
232. Arthroscopy	327	62	389	84.06
262. Breast biopsy and local excision for non-malignancy	564	69	633	89.10
267. Perianal and pilonidal procedures	398	211	609	65.35
339. Testes procedures, non-malignancy age >17 years	98	198	296	33.11
340. Testes procedures, non-malignancy age <18 years	41	156	197	20.81
342. Circumcision, age >17 years	746	3	749	99.60
343. Circumcision, age <18 years	266	31	297	89.56
351. Sterilization, male	537	0	537	100
361. Laparoscopy and incisional tubal interruption	58	52	110	52.73
362. Endoscopic tubal interruption	1	9	10	10
364. Dilation and curettage, conization except for malignancy	167	87	254	65.75
494. Laparoscopic cholecystectomy without CC	16	790	806	1.99
Total	19640	6387	26027	75.46

Region of Murcia 2002–2003. DRG: diagnosis related group; CC: complication-comorbidity; MAS: major ambulatory surgery; SI: substitution index.

patient surgery services. The number of beds in the hospitals in the study ranged from 78 to 944.

We considered as MAS cases all scheduled interventions which required 0 days of hospitalization and were included in 1 of the 31 DRG's that had been previously selected to be part of this study.

In preparing our list, we took into account the DRG's on the MAS list used by INSALUD¹ and the reality of the region as regards the use of these procedures in the hospitals included in the study. To do so, we did an initial search of the databases to identify cases of specialized ambulatory care for the years 2002 and 2003. We generally excluded medical DRG's, except category 351 (male sterilization). We also excluded those which had a high probability of producing confusion given the different type of procedures included under some headings (for example: "other surgical procedures"). Finally, we also excluded all DRG's with complications-comorbidity (CC).

The SI was calculated as the percentage of ambulatory care interventions (0 hospital days) in relation to the total number of scheduled interventions for the selected DRG's.

The number of potentially avoidable admissions and stays was obtained using the total number of cases that required hospitalization, with the exception of emergency admissions and cases that involved complications, psychiatric pathology, drug addiction, mentally handicapped persons and/or stays of more than 14 days [2].

DRG's with the best prospects for improvement were those in which the percentage of potentially avoidable stays was the highest.

In order to ensure the reliability of the indicators that were studied and to avoid random variability, all results were calculated as the average for the 2 years included in the study.

3. Results

Table 1 shows the cases which were rejected as potentially ambulatory after applying the exclusion criteria which were used for each one of the 31 selected DRG's. The cases

¹ The Federal Institute that managed the health care system in the Autonomous Region of Murcia until 2002.

with complication-comorbidity are not included because the DRG's that included an annotation of this type were excluded from the study.

The table shows that the application of the exclusion criteria eliminated 33.12% of all potential ambulatory cases. Of all of the factors that were studied, the one with the greatest impact was whether the admission was emergency or scheduled. This factor was found in 97.19% of the excluded cases.

Table 2 shows the number of interventions performed in the region for each DRG and its SI. The average overall SI for both years was 75.46%. The highest SI (100%) was for DRG 351 (male sterilization) and the lowest was for DRG 494

(1.99%) (laparoscopic cholecystectomy without CC). Apart from male sterilization, we find a SI of 90% or higher for adult circumcision, carpal tunnel procedures and some ophthalmologic procedures. Laparoscopic cholecystectomy and endoscopic tubal interruption had a SI of 10% or lower.

Table 3 shows the SI for each DRG in each hospital as well as the total for the region and the rates ratios. In this case DRG's have been organized from the highest to the lowest SI for the whole region. The SI for the hospitals in the study ranged from 82.75% for H1 to 61.85% for H2 (rates ratio of 1.34).

Table 4 shows the DRG's listed from highest to lowest impact on avoidable stays. The average annual admissions

Table 3
Substitution index by hospital and rates ratios

DRG	Total region	H1	H2	H3	H4	H5	H6	RATESRATIO
351. Sterilization, male	100	–	–	100	100	100	100	1
342. Circumcision, age >17 years	99.60	100	–	99.63	100	97.83	99.65	1.02
39. Lens procedures with or without vitrectomy	97.43	99.78	99.64	99.28	88.91	87.91	97.27	1.13
40. Extraocular procedures except orbit, age >17 years	95.18	87.63	98.32	99.58	90.48	95.76	95.65	1.14
6. Carpal tunnel release	94.26	95.32	98.44	10	95.43	93.65	99.66	9.97
41. Extraocular procedures except orbit, age <18 years	92.91	95.83	100	72.22	94.74	100	57.14	1.75
38. Primary iris procedures	90.91	100	100	100	–	100	86.96	1.15
343. Circumcision, age <18 years	89.56	89.87	–	77.17	93.55	100	100	1.30
262. Breast biopsy and local excision for non-malignancy	89.10	86.57	51.52	93.40	60.87	97.30	96.69	1.89
232. Arthroscopy	84.06	92.96	87.5	0	0	0	91.37	Cases with zero
229. Hand or wrist procedures, except major joint procedure, without CC	81.66	87.22	82.47	11.54	86.42	70.59	86.70	7.56
60. Tonsillectomy and/or adenoidectomy only, age <18 years	76.95	82.69	–	0	23.81	8.82	87.77	Cases with zero
42. Intraocular procedures except retina, iris and lens	69.28	88.89	72.5	98.25	68.18	37.50	37.50	2.62
364. Dilatation and curettage, conization except for malignancy	65.75	92.59	66.67	61.90	43.86	66.15	–	2.11
267. Perianal and pilonidal procedures	65.35	37.14	2.35	40	88.89	97.10	95.88	41.27
225. Foot procedures	65.27	70.97	98.14	0	32.26	12	63.64	Cases with zero
158. Anal and stomal procedures without CC	58.42	17.50	2.61	16.67	58.24	78.02	81.01	31.05
227. Soft tissue procedures without CC	56.25	27.08	76	39.13	60	20	72.57	3.80
163. Hernia procedures, age <18 years	54.75	54.30	0	0	77.78	100	81.82	Cases with zero
361. Laparoscopy and incisional tubal interruption	52.73	96.36	0	0	40	50	–	Cases with zero
231. Local excision and removal of internal fix devices except hip and femur	51.98	41.80	51	19.05	64.52	20	69.57	3.65
59. Tonsillectomy and/or adenoidectomy only, age >17 years	48.54	25	–	12	0	–	68.66	Cases with zero
55. Miscellaneous ear, nose, mouth and throat procedures	47.81	22.81	–	4.67	6.98	8.47	66.81	14.32
119. Vein ligation and stripping	46.48	6.90	1.03	10	38.89	17.02	76.98	74.67
162. Inguinal and femoral hernia procedures, age >17 years without CC	46.29	4.42	0.54	2.74	39.37	70.34	81.77	151.27
160. Hernia procedures except inguinal and femoral, age >17 years without CC	41.26	20.27	2.46	2.53	35.87	75.49	59.77	30.70
36. Retinal procedures	39.60	44.05	67.62	100	48.28	–	2.59	38.67
339. Testes procedures, non-malignancy age >17 years	33.11	0	100	3.49	19.44	0	56	Cases with zero
340. Testes procedures, non-malignancy age <18 years	20.81	18.06	–	0	33.33	0	60.87	Cases with zero
362. Endoscopic tubal interruption	10	0	–	–	0	50	–	Cases with zero
494. Laparoscopic cholecystectomy without CC	1.99	0	0	0	4.60	1.30	2.52	Cases with zero
Total	75.46	82.75	61.85	69.41	69.97	66.72	79.61	1.34

Region of Murcia 2002–2003. DRG: diagnosis related group; CC: complication-comorbidity.

Table 4
Number and percentage of avoidable stays

DRG	H1	H2	H3	H4	H5	H6	Total region	
	N	N	N	N	N	N	N	%
494. Laparoscopic cholecystectomy without CC	170	36	494	196	244	1063	2203	14.19
55. Miscellaneous ear, nose, mouth and throat procedures	591	0	284	81	114	866	1936	12.47
160. Hernia procedures except inguinal and femoral, age >17 years without CC	293	159	339	206	98	569	1664	10.72
162. Inguinal and femoral hernia procedures, age >17 without CC	280	469	196	279	203	232	1659	10.68
231. Local excision and removal of internal fix devices except hip and femur	307	137	196	60	70	197	967	6.23
158. Anal and stomal procedures without CC	278	140	48	81	44	332	923	5.94
36. Retinal procedures	193	60	0	28	0	419	700	4.51
225. Foot procedures	51	15	187	82	147	175	657	4.23
119. Vein ligation and stripping	55	145	41	77	106	129	553	3.56
339. Testes procedures, non-malignancy age >17 years	19	0	217	105	50	127	518	3.34
42. Intraocular procedures except retina, iris and lens	69	56	7	9	8	313	462	2.98
227. Soft tissue procedures without CC	200	36	52	21	34	103	446	2.87
60. Amigdalectomía y/o adenoidectomía solo, edad <18 years	83	0	91	58	41	141	414	2.67
39. Lens procedures with or without vitrectomy	24	4	19	117	64	132	360	2.32
267. Perianal and pilonidal procedures	56	206	4	13	5	23	307	1.98
340. Testes procedures, non-malignancy age <18 years	200	0	50	5	23	17	295	1.90
229. Hand or wrist procedures, except major joint procedure, without CC	30	75	78	24	18	40	265	1.71
262. Breast biopsy and local excision for non-malignancy	100	26	13	16	2	9	166	1.07
163. Hernia procedures, age <18 years	143	10	2	2	0	6	163	1.05
40. Extraocular procedures except orbit, age >17 years	95	2	2	6	8	35	148	0.95
361. Laparoscopy and incisional tubal interruption	5	112	15	11	1	0	144	0.93
364. Dilation and curettage, conization except for malignancy	8	11	34	65	24	0	142	0.91
59. Tonsillectomy and/or adenoidectomy only, age >17 years	11	0	50	14	0	51	126	0.81
232. Arthroscopy	10	1	14	15	36	36	112	0.72
6. Carpal tunnel release	13	3	43	16	6	1	82	0.53
343. Circumcision, age <18 years	17	0	38	3	0	0	58	0.37
41. Extraocular procedures except orbit, age <18 years	11	0	9	3	0	11	34	0.22
362. Endoscopic tubal interruption	2	0	0	10	1	0	13	0.08
38. Primary iris procedures	0	0	0	0	0	6	6	0.04
342. Circumcision, age >17 years	0	0	1	0	2	1	4	0.03
351. Sterilization, male	0	0	0	0	0	0	0	0
Total	3314	1703	2524	1603	1349	5034	15527	100

Region of Murcia 2002–2003. DRG: diagnosis related group; CC: complication-comorbidity.

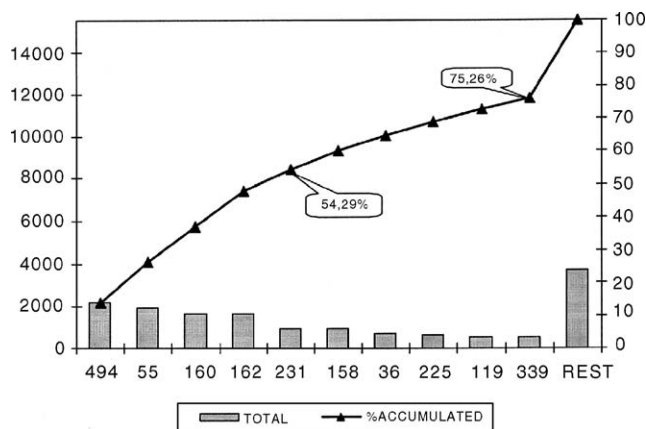


Fig. 1. Number and percentage of avoidable stays, 2002–2003.

and potentially avoidable hospital days was 3194 and 7764, respectively. 54.29% of the avoidable stays (Fig. 1) pertained to five DRG's (494, 55, 160, 162 and 231).

4. Discussion

The study of the SI of MAS requires previous decision making related to the classification system that should be used to study this kind of surgery, the number and the type of procedures to include and the exclusion criteria to be used.

As regards the first point, most of the comparative studies done internationally use one of the following classification systems: the ICD-9-MC, the DRG or systems developed by the researchers themselves [3]. Although the most frequently used system is the ICD-9-MC, we chose to use the DRG system because it has become one of the most commonly used by clinicians and management alike [4].

One of the problems with using DRG's is that they are comprised of more or less homogeneous groupings of patients with similar resources consumption. This creates a risk that a procedure that is not on the list might be included in the study. We have tried to solve this problem by selecting a limited number of DRG's that appear in most of the lists used by the health authorities in Spain and by the now defunct INSALUD, excluding besides all those that include "other surgical procedures" in their headings.

The alternative to this solution would have been to study these procedures using the corresponding code from the ICD-9-MC system under the heading of main surgical procedure according to the MBDS. It is important to point out that this field is not always the same in the MBDS's of all of the hospitals in the study (most of the times is the field T1 but other times is the C1 one) and that there exists a wide margin for improvement in the collection of this variable in their data sets [5]. This is due to the fact that the procedure indicated is not always the principal one related to the main diagnosis. We agree with other authors who feel that this factor could seriously affect the results [6].

As regards the exclusion criteria, we have used the surgical exclusion criteria for out-patients that have been adapted for use in the MBDS's which were agreed to in a Delphi study carried out in Valencia [2]. However, we must point out that no restrictive criteria related to age have been applied due to the large number of MAS interventions involving children under 15 years of age performed at the hospitals involved in the study and to the existence of studies that include paediatric cases [7].

In addition to this, it is important to understand that the use of clinical-administrative MBDS databases in this kind of study does not allow us to monitor other factors such as previous cases of complications due to anaesthesia, unaccompanied patients, the condition of the patient's home, or patient consent. This means that the study might include cases considered to be potentially ambulatory which were really not.

Table 1 shows the impact on inclusion in the study of cases of MAS according to the three exclusion criteria used. As mentioned earlier, the most important factor was whether the admission was scheduled or emergency. However, given that the criteria used to record this variable (type of admission) varies from hospital to hospital and that some studies do not exclude cases that were emergency admissions when calculating this indicator [8] (and since there are many cases, this affects in great measure the calculation of the SI), it would be wise to analyze the impact of this factor for each DRG by calculating two SI values, one for all of the cases and another one for scheduled procedures only.

The DRG's with the highest number of exclusions were 364 (dilation and curettage, conization except for cases of malignant neoplasia), 229 (hand or wrist procedures, except major joint procedures, without CC) and 158 (anal and stomal procedures without CC).

The SI's obtained in this study are shown in Tables 2 and 3. The global SI was 75.46%, similar to the average of 75%

obtained in the Delphi study done in Catalonia in 1995 [9] and a bit higher than the 65% and 70% found in the United Kingdom and the United States in the 2-year period 1998–1999 [10], although we should consider the time that has passed in both cases and the differences in the procedures included and the exclusion criteria used.

Even though it was not possible to monitor all of the factors, could lead us to think that the SI might be even higher than the one we report, the use of a small list of DRGs, the problem with the type of admission variable and the fact that some hospitals might not offer this kind of surgery suggests that the SI is probably even lower than the one we obtained in this study. In other words, the margin for improvement is even greater.

As regards SI for DRG, it is useful to compare this study to another one carried out in Catalonia where this patient classification system was also used to analyze this type of care [11]. In this paper, the SI was also high for the public hospitals in cases of lens, hand or wrist surgery and for non-malignant dilation and cutterage, non-malignant breast tumours and adult circumcisions; and low in inguinal and femoral hernias in adults, paediatric hernias and laparoscopic tubal interruption. For this last type of surgery, the SI in Murcia was much higher than the one found in Catalonia, while just the opposite was true for endoscopic tubal interruption in which the SI was much lower in Murcia.

The results of this study are only applicable to those hospitals similar to the ones that have participated in the study and that use similar methods. In addition to this, we have to bear in mind in order to compare, that in some studies, cases that involve a hospital stay of more than 23 h post-operatively are being counted as MAS. These patients should be considered inpatients, because this sort of surgery is less cost-effective than MAS and the inclusion of these cases produces a distortion of the results [10].

There is a wide margin for improvement in relation to the performance of MAS procedures in the six hospitals that were included in this study in the Region of Murcia. In addition, we should also mention that there are two hospitals that provided no information about this type of surgery and another one where it has not been implemented yet.

Five DRG's (laparoscopic cholecystectomy, miscellaneous ear, nose, mouth and throat procedures, hernia procedures in adults and the removal of internal fixation devices except hip and femur) account for more than 50% of potentially avoidable days of stay. This is a relevant factor because these are procedures for which there are more efficient treatment alternatives and because the waiting lists for these procedures in the public health-care system are quite long [1]. According to the latest data published by the Spanish Ministry of Health, inguinal hernia procedures and cholecystectomies appear in second and sixth place, respectively, in the number of patients on waiting lists [12]. In addition, these are procedures for which the SI's for the different hospitals studied vary greatly and surpass, in all the cases, the average reached for all of the DRG's (Table 3). Due to this

variability, it is easy to identify the hospital with the highest incidence of this type of intervention for each specific procedure.

At a more specific level and with respect to laparoscopic cholecystectomies, the SI obtained in this work (1.99% average with a maximum of 4.60%) is much lower than the one reported in a national study (90%). This high SI was reached thanks to the use of preventative analgesics, non-opiate anaesthesia and intra-operative intraperitoneal anaesthetics during the procedure [13].

In order to promote this approach to surgery, changes in financing and incentive policies and new procedures should be introduced, protocols should be updated, and benchmarking strategies should be established.

Other studies that have been done show that financing is the most important factor in promoting this option [2,4,14–18]. In 1999, INSALUD changed the payment structure from one based on fixed payments to one based on payment per procedure using the DRG's. This meant that the hospital received the same funding when they used a MAS approach for interventions as they did when they used an inpatient approach. This was a significant change and increased the use of this kind of intervention as we can see monitoring the SI for each type of process. The future use of patient classification systems specifically designed for ambulatory care will bring about yet more changes in this regard.

One solution regarding incentive policies could be to change the present system for another one that better discriminates merit and achievement among professionals [18].

Over the last few years, the development of minimally invasive surgical techniques (arthroscopy, laparoscopic sterilization, therapeutic or surgical endoscopy, etc.) has increased the number of outpatient procedures [10,17]. While modifying the technological competence of the hospital is necessary in order to offer more ambulatory surgery, it is not the only change that needs to be made. In some cases, inpatient surgery is done when outpatient surgery would be just as good so that the hospital can comply with the goals set by the government as regards the reduction of hospital stays for inpatients.

The revision of current protocols should take into account the most recent advances in both anaesthesia, with the emergence of shorter action drugs that have fewer side effects [2,10,13,17,19], and in post-operative care techniques. The success of ambulatory surgery depends to a great extent on these factors which make it a much more attractive option for the patient. Patients will be able to count on the support of the healthcare staff who will make a follow-up call 24 h post-operatively and be available 24 h a day to answer any questions they might have [10,20].

The high variability that we see in the SI's of the DRG's with the highest number of avoidable stays, suggests that benchmarks should be established among the hospitals that show the highest SI's and those with lower values for a specific process.

There is no reason why this approach should not be implemented given that procedures performed in this way are more efficient and safer than those done using some of the traditional approaches and patient satisfaction is also higher. There is a wide margin for improvement and for the implementation of corrective measures.

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