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ORIGINAL ARTICLE

A multicenter study on the appropriateness of hospitalization in obstetric wards: application of Obstetric Appropriateness Evaluation Protocol (Obstetric AEP)

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Abstract

The cross-sectional study has been based on the implementation of the Obstetric Appropriateness Evaluation Protocol (OAEP) in seven hospitals to determine inappropriate hospital admissions and days of stay. The outcomes were: inappropriateness of admission and "percentage of inappropriateness" for one hospitalization. A total number of 2196 clinical records were reviewed. The mean percentage of inappropriateness for hospitalization was 22%. The percentage of inappropriateness for the first 10 d of hospitalization peaked in correspondence of the fourth (42%). The logistic regression model on inappropriated admission reported that emergency admission was a protective factor (OR = 0.4) and to be hospitalized in wards with ≥30 beds risk factor (OR = 5.12). The second linear model on "percentage of inappropriateness" showed that inappropriated admission and wards with ≥30 beds increased the percentage ($p < 0.001$); whereas the admission in Teaching Hospitals was inversely associated ($p < 0.001$). The present study suggests that the percentage of inappropriate admission depends especially on the inappropriate admission and the large number of beds in obstetric wards. This probably indicates that management of big hospitals, which is very complex, needs improving the processes of support and coordination of health professionals. The OAEP tool seems to be an useful instrument for the decision-makers to monitor and manage the obstetric wards.

Keywords

Appropriateness evaluation protocol, appropriateness of hospital use, inappropriateness, obstetrics

History

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Introduction

The current use of hospital resources is partly inadequate, either because provided healthcare does not result into health benefits for patients or because healthcare services could be provided at different institutional levels with a consequent costs reduction [1]. Healthcare provided by hospitals is characterized by a significantly variable level of inappropriateness, due to unjustified admissions and/or length of stay [2]. As showed by the available scientific evidences, 10–30% of hospital admissions are not necessary. Thus, optimizing the use of hospital resources, through costs rationalization and reduction, without compromising the quality of care provided should become the goal of all healthcare providers [3]. In this perspective, the evaluation of the use of hospital resources allows to identify organizational problems and define the actions needed to correct them [1].

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The Appropriateness Evaluation Protocol (AEP), introduced in 1981 in the USA by Gertman and Restuccia in order to evaluate the potentially unnecessary admissions or hospital days of care, represents, to date, a widely used assessment tool, characterized by satisfactory validity and high reproducibility [4,5]. It has been tested more widely and is used, both in the United States and in many European countries, as an indicator of systemic problems in the organization of healthcare delivery [6,7]. The AEP, which was designed to be a diagnosis independent tool for patients in adult medicine, surgery and gynecology, consists of criteria based on objective measures of severity of disease and required level of care [3,6]. After its translation, testing and adapting to the Italian context, it has been applied to different clinical care settings and it is usually indicated by the term PRUO (Protocollo Revisione Utilizzo Ospedale, Review Protocol of Hospital Use) [8–18].

The aim of the present study was to carry out a multicenter study on the appropriateness of hospitalization in obstetric wards by applying the ''Obstetric PRUO'' (alias ''Obstetric Appropriateness Evaluation Protocol'', OAEP) proposed in 2009 by Poppa et al. [2], which is a tool specifically designed to monitor the use of hospitals and the allocation of resources related to the obstetric setting. It has been tested within the Pediatric Hospital ''Regina Margherita'' and the Obstetrics and Gynecology Teaching Hospital ''S. Anna'' in Turin showing to be useful for analyzing the main determinants of inappropriate admissions and hospital stays [2]. This study has been based on the implementation of the Obstetric PRUO within seven Italian hospitals in order to determine the extent of inappropriate hospital admissions and days of stay and to identify the main related variables.

Methods

Study design and sample size

A cross-sectional study was carried out according to the STROBE checklist [19,20]. It was conducted by analyzing the clinical records (CRs) of seven different hospitals in Italy: one in the North of the Country, two in the Center (both of them were Teaching Hospitals) and four in the South (one of which was a Teaching Hospital). The hospitals enrolled in the study were: ''S. Anna'' in Turin (Northern Italy), ''Gemelli'' and ''Umberto I'' Teaching Hospitals in Rome (Center Italy), ''SS. Filippo e Nicola'' in Avezzano (Center Italy), ''P. Giaccone'' Teaching Hospital in Palermo (Southern Italy), ''Maria Immacolata'' in Sapri in the district of Salerno (Southern Italy), and ''M. Scalato'' in Salerno (Southern Italy).

The study protocol and the consensus to examine the CRs were approved by the Ethics Committee and the Medical Direction of the coordinator hospital (Umberto I Teaching Hospital). The consensus was shared with the Medical Directions of the other engaged hospitals.

The CRs were related to hospitalizations occurred in 2009.

The number of CRs needed was determined with the following assumptions:

- significant level was set at 0.05 and power at 0.8;
- prevalence of inappropriateness was set at 3.3%, according to literature (Poppa et al. [2]);
- the farthest result from the prevalence of inappropriateness that was accepted was fixed at $\pm 2\%$.
- for each obstetric ward the total number of hospitalizations in 2009 was counted.

The sampling days were rotated so that all days of the week were equally represented during a 7-week period. The same approach was adopted for the sampling seasons.

Appropriateness evaluation protocol tool

The OAEP, published by Poppa et al. [2], was chosen as a tool to assess the hospital admissions and days of stay for ordinary hospitalizations.

The protocol included 49 criteria divided in two sections, the first one for admission day (from code number 1 to code number 28), and the second one for hospital stay days (from code number 29 to code number 49).

A preliminary meeting with an obstetrician researcher was called with each working group, in order to harmonize the knowledge and the practical aspects.

The CRs were all assessed independently by two professionals (researchers or young resident doctors in Public Health) using the Obstetric PRUO. After the assessment the two reviewers compared their judgments and in case of discrepancy they found an agreement in order to obtain a single evaluation document (ED) for each CR.

The reason of appropriateness/inappropriateness for each day of hospitalization has been indicated from the operator with a number on the basis of the information reported in the CR.

In addition the socio-demographic variables and characteristics of hospitalization were collected: age, civil status, type of hospitalization (planned/emergency), hospitalization during the weekend (yes/no), hospitalization during the autumn/winter (versus spring/summer), teaching hospital (yes/no), geographical area (north/center/south) and number of hospital beds (<30 or ≥ 30).

Every center sent the EDs to the Department of Public Health and Infectious Diseases of the ''Sapienza'' University, which was the Coordinator Unit.

Statistical analysis

A centralized data entry was performed using dBase IV software (Borland International, Scotts Valley, CA).

All analyses were carried out using SPSS for Windows (Statistical Package for the Social Sciences, Version 19; SPSS, Inc., Chicago, IL).

The qualitative variables were described as frequencies and percentages and recoded into dummies if needed, while the continuous ones (age, percentage of inappropriateness and length of hospitalization) as mean and Standard Deviation (SD).

The outcomes examined were:

(a) appropriateness/inappropriateness of admission;
(b) percentage of inappropriateness (number of inappropriate days/length of hospitalization).

To evaluate the possible associations between outcomes and categorical covariates, the Chi-square test or the Fisher's Exact test whenever the sample sizes were rather small, were used.

The Odds Ratios (ORs) with corresponding Confidence Intervals at 95% (95% CI) were calculated in order to estimate the risk of inappropriateness for dichotomous variables.

According to the sample size and the normality distribution, *t*-student test (assumed equal or unequal variances as appropriate) and one-way analysis of variance followed *post-hoc* analysis (Tukey's test) were used to compare continuous variables. The Kolmogorov–Smirnov's test to check the normality was applied.

A multivariate logistic regression model was performed to study the outcome inappropriate admission, while a multivariate linear regression to study the percentage of inappropriateness.

The inclusion of any covariate in the models was decided on the basis of the univariate analysis (p value lower that 0.25).

All models were adjusted for: geographical area of the hospital, type of hospital, type of hospitalization, length of hospitalization, number of hospital beds, day of week and season.

Stepwise with backward elimination of non-significant variables (probability to entry $p<0.05$) was subsequently used to generate a minimal model.

The goodness of fit for the models was assessed with Hosmer and Lemeshow's test for the logistic model [21] and with R^2 for the linear one.

Significance threshold was set at $p<0.05$ (two-tailed) for all analyses.

Results

The total of CRs reviewed were 2196: 29% in the North, 51% in the Center and 21% in the South of Italy.

The mean age of patients was 32 years (SD = 5.8; min = 15 and max = 51), the 66% of them were married and 88% lived in same province of the hospital and 54% in the same city.

The length average of hospitalization was 5 d with SD = 3.9. The mean percentage of inappropriateness (n. inappropriate days/length in days × 100) for one hospitalization was 22%(about one fifth). The inappropriateness distribution for the first 10 d is showed in Figure 1: the maximum percentage was obtained in correspondence of fourth and fifth hospitalization stay day, 42% in both of cases.

In Table 1 the characteristics of the sample stratified by appropriateness of admission are shown.

Significant associations were found between inappropriateness and type of admission, type of hospital, geographical area, day of the week, percentage of inappropriateness and season ($p<0.05$). In particular the emergency admission was a protective factor of inappropriated admission, OR = 0.23 95% CI (0.16–0.35). To be hospitalized in a Teaching Hospital, in a hospital with ≥ 30 beds and to be admitted during the Winter/Autumn and in the workweek were risk factors of inappropriateness, respectively with OR = 3.50 95% CI (2.30–5.34), OR = 2.04 95% CI (1.41–2.97), OR = 2.14 95% CI (1.41–2.97), OR = 1.85 95% CI (1.12–3.04).

Moreover, the admission in Center of Italy hospitals was more likely to have risk of inappropriateness admission ($p<0.001$).

Table 2 shows that the greater percentage of inappropriateness was found to be associated with planned admission (29%, SD = 28, $p<0.001$), type of hospital (25%, SD = 24, $p<0.001$), number of beds ≥30 (33%, SD = 24, $p<0.001$), inappropriated admission (65% SD = 30, $p<0.001$) and admission during the Winter or Autumn (23, SD = 26, $p<0.011$). In addition the *post-hoc* multiple analysis (Tukey's test) showed that the North geographical area was characterized by a higher percentage of inappropriateness (31%) in comparison with the Center (21%) and South (11%).

The multivariate regression models are illustrated in Table 3.

The first one, a logistic model, showed that the emergency admission was a protective factor of inappropriate admission (OR = 0.40, CI 95% [0.25–0.62]), while a higher number of beds was a risk factor (OR = 5.12 CI 95% [3.23–8.11]). The Hosmer Lemeshow's statistic had a p value of 0.167,

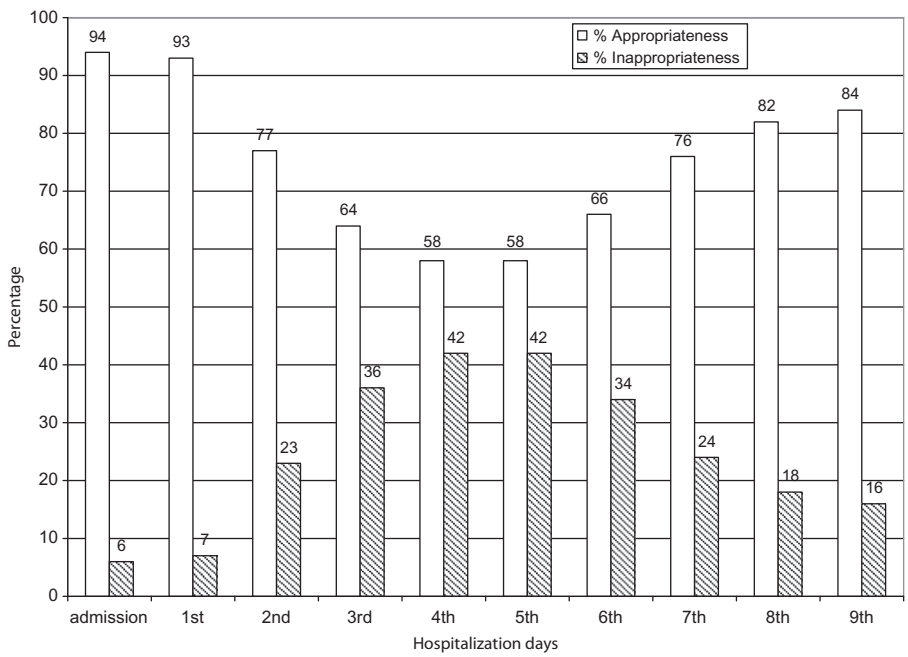

Figure 1. Distribution of appropriateness and inappropriateness percentages for the first 10 d of hospitalization in the sample.

Table 1. Distribution of the appropriateness of admission day by hospitalization characteristics and features of patients.

Variables	Appropriateness* ($N=2071$) *N* (%)	Inappropriateness* ($N=121$) *N* (%)	*p*†
Admission (missing = 175)			
Planned	389(87.0)	58(13.0)	**<0.001**
Emergency	1521(96.6)	53(3.4)	
Type of hospital			
Hospital	1110(97.4)	30 (2.6)	**<0.001**
Teaching hospital	961 (91.3)	91 (8.7)	
Geographical area			
North	618 (99.0)	6 (1.0)	**<0.001**
Center	1026 (91.7)	93 (8.3)	
South	427 (95.1)	22 (4.9)	
Admission during the workweek			
No	530(96.5)	19(3.5)	**0.016**
Yes	1541 (93.8)	102 (6.2)	
Admission during the winter/autumn			
No	1163 (95.5)	55 (4.5)	**0.021**
Yes	908 (93.2)	66 (6.8)	
Number of hospital beds			
<30	1222 (96.1)	50 (3.9)	**<0.001**
≥30	849(92.3)	71 (7.7)	
Length of hospitalization			
Mean (SD)	5.1 (3.9)	5.7 (3.9)	0.097‡

*Total missing value = 2.
†*p* value of χ^2 test.
‡*p* value of two Sample *t*-tests with unequal variances.
bold: $p<0.05$.

Table 2. Univariate analysis for the percentage of appropriateness in comparison to the hospitalization and patients characteristics.

	Percentage of inappropriateness*	
Variables	% mean (SD)	*p*
Admission		
Planned	29 (28)	**<0.001**
Emergency	20 (23)	
Type of hospital		
Hospital	25 (24)	**<0.001**†
Teaching hospital	18 (25)	
Number of beds in obstetric ward		
<30	13 (22)	**<0.001**
≥30	33 (24)	
Geographical area of the hospital		
North	31 (21)	**<0.001**‡
Center	21 (25)	
South	11 (23)	
Admission during the weekend		
Yes	21 (24)	0.067†
No	23 (25)	
Admission during the Winter or Autumn		
Yes	23 (26)	**0.011**¶
No	20 (24)	
Inappropriate admission		
Yes	65 (30)	**<0.001**¶
No	19 (22)	

*(number of inappropriate days/length of hospitalization) × 100.
†*p* value of two Sample t-tests with equal variances.
‡*p* value of ANOVA one-way test.
¶*p* value of two Sample *t*-tests with unequal variances.
bold: $p<0.05$.

which also suggests that the model cannot be rejected with any acceptable level of statistical significance.

The linear model underlined that the percentage of inappropriateness was increased in inappropriate admission ($b=0.45$, $p<0.001$) and in obstetric wards with ≥ 30 beds ($b=0.29$, $p<0.001$). On the other hand, the admission in a Teaching Hospital and the hospitalization in South or in North Italy were inversely associated to the percentage of inappropriateness (respectively: $b=-0.16$, $p<0.01$; $b=-0.13$, $p<0.001$). The R^2 coefficient was 0.367, suggesting that the model was quite respectable in comparison with the high significant levels of covariates.

Tables 4–6 show the distribution of the criteria of appropriateness and the reasons of inappropriateness for the admission and the first 5 d of stay.

The higher percentage of inappropriateness was due to: ''Patient waiting diagnostic tests'' followed by ''Patient waiting surgical intervention/carrying out childbirth'' for the admission; ''Patient waiting diagnostic tests'' for the first day of stay; ''other causes (specifying, especially if it is dealing with performance of medical/physical/rehabilitation therapy)'' for the second day; ''Patient waiting surgical intervention/carrying out childbirth'' for the third day; and ''other causes'' for the fourth and fifth days.

Discussion

The findings of this multicenter study showed that the length of the hospitalization and the planned admission are the main drivers for inappropriateness of admission. These results confirm those reported by Poppa et al. [2], in which the OAEP was implemented within the Pediatric Hospital ''Regina Margherita'' and the Obstetrics and Gynecology Teaching Hospital ''S. Anna'' in Turin.

The higher level of inappropriate admissions or days of hospital stay may be due to the size of the hospital (number of beds) and to the type of admission.

The current study showed an inverse association between the hospitalization in South Italy and the percentage of inappropriateness. This geographical difference could depend on the fact that patients from the South part of Italy often are admitted in hospitals located either in Northern or Central Italy.

In addition others factors not analyzed might to have contributed to create a difference, for example:

- staffing of the different hospital services (ancillary, nursing, operating hours, etc.)
- geographical and transportation barriers for patients
- decision-making process, since many of the hospital were teaching hospitals who had the authority to admit and discharge patients.
- did hospitals maintain or enforce a peer review process to address these issues.

Likewise the study by Poppa et al. [2], the planned admission resulted to be a significant risk factor of inappropriateness (OR = 4.2 versus OR = 2.9). Concerning the following 5 d of stay in hospital, there is an exponential increase in the percentage of inappropriate days reaching a maximum value of 42% in accordance to Poppa et al. [2]. This is likely due to the specificity of obstetrics: both child birthing and abortion and other complications of pregnancy are resolved in 24–48 h of stay in hospital, making appropriate hospitalization during this time period.

The main reasons of inappropriateness resulted to be related to the patient waiting for tests or results (44%) in

Table 3. Multivariate regression models for inappropriate admission and percentage of appropriateness outcomes.

	Outcomes				
	Inappropriate admission (yes/no)				
		95% CI		Percentage of inappropriateness	
Independent variables	OR	Low	Up	B	*p*
Admission					
Planned*	**1**	**0.25**	**0.62**	−0.23	0.818
Emergency	**0.40**				
Type of hospital					
Hospital*	1	0.56	2.10	−0.16	**<0.001**
Teaching Hospital	1.08				
Number of hospital beds					
<30*	**1**	**3.23**	**8.11**	0.29	**<0.001**
≥30	**5.12**				
Geographical area of the hospital in Italy					
Center*	1	0.46	1.99	−0.13	**<0.001**
North/South	0.96				
Admission during the workweek					
Yes	1.44	0.82	2.51	−0.02	0.464
No*	1				
Admission during the Winter or Autumn					
Yes	1.33	0.87	12.03	0.04	0.097
No*	1				
Inappropriate admission					
Yes	–	–	–	**0.45**	**<0.001**
No*					
Goodness of fit		0.167†		0.367‡	

*Reference group.
†Hosmer and Lemeshow's test.
‡R^2.
– Not included in the model, because is the dependent variables.
bold: $p < 0.05$.

Table 4. Distribution of criteria/causes for admission day stratify by Italian geographical areas.

	Total (Missing = 4)		North (Missing = 0)		Center (Missing = 3)		South (Missing = 1)	
Admission day code	*N*	(%)	*N*	(%)	*N*	(%)	*N*	(%)
Appropriate criteria								
1. Blood pressure: systolic <90 or >140, diastolic <60 or >90	62	3.08	27	4.37	34	3.33	19	4.74
2. Armpit temperature >38 °C for 5 d	8	0.40	4	0.65	3	0.29	11	2.74
3. Bleeding in act from external genitalia or in the last 48 h	140	6.95	26	4.21	83	8.12	31	7.73
4. Loss of amniotic fluid from external genitalia	56	2.78	8	1.29	41	4.01	7	1.75
5. Finding of uterine contractile activity from 1 h (3 contractions in 10')	150	7.45	25	4.05	102	9.98	23	5.74
6. CTG/AFI not satisfying reactivity criteria	47	2.33	10	1.62	35	3.42	2	0.50
7. Finding of cervical dilatation at gestation time <34 weeks	10	0.50	4	0.65	6	0.59	0	0.00
8. Acute thoracic or epigastria pain with hemodynamic alterations	8	0.40	3	0.49	5	0.49	0	0.00
9. Hydro-electrolytic, acid–base or metabolic imbalance	58	2.88	28	4.53	27	2.64	3	0.75
10. Abdominal/pelvic pain that need pain-killer i.v. Therapy	61	3.03	19	3.07	31	3.03	11	2.74
11. Presence of breathing, neurological, circulating, sensitive, motor illness	28	1.39	12	1.94	16	1.57	0	0.00
12. Medical/obstetric observation (three times or more) in 24 h	131	6.51	2	0.32	91	8.90	38	9.48
13. Midwifery/nursing observation (four times or more) in 24 h	34	1.69	3	0.49	27	2.64	4	1.00
14. Monitoring vital parameters/FHR (three times or more)	41	2.04	1	0.16	37	3.62	3	0.75
15. Invasive diagnostic/therapeutic procedures in O.R or delivery room	1139	**56.58**	441	**71.36**	473	**46.28**	**225**	**56.11**
16. Therapy and side effects control	2	0.10	0	0.00	2	0.20	24	5.99
17. I.V. administration in 24 h	38	1.89	5	0.81	9	0.88	19	4.74
Total of appropriate admission days	2013	100.00	618	100.00	1022	100.00	401	100.00
Inappropriate reasons								
20. Execution of diagnostic tests	72	**57.60**	1	16.67	58	**60.42**	13	**56.52**
21. Execution of medical therapeutic interventions	12	9.60	2	**33.33**	8	8.33	2	8.70
22. Execution of surgical intervention, childbirth waiting	21	16.80	1	16.67	18	18.75	2	8.70
23. Basic obstetric/nursing assistance	13	10.40	2	**33.33**	8	8.33	3	13.04
25. Overall critic clinic situation	4	3.20	0	0.00	3	3.13	1	4.35
28. Other	3	2.40	0	0.00	1	1.04	2	8.70
Total of inappropriate admission days	125	100.00	6	100.00	96	100.00	23	100.00

Bold values signify maximum percentage.

Table 5. Distribution of criteria/reasons for the first stay day stratify by Italian geographical areas.

1st day stay	Total		North		Center		South	
Code	*N*	(%)	*N*	(%)	*N*	(%)	*N*	(%)
Appropriate criteria								
29. Procedures in operating room or delivery room in the day	511	27.53	202	21.54	201	34.60	108	32.05
30. Procedures in O.R. in the next day, but requiring pre-operative consultations or valuations extra-routine	40	2.16	19	2.03	7	1.20	14	4.15
31. Medical/obstetrician observation at least three times	187	10.08	112	11.94	34	5.85	41	12.17
32. First post-partum/post-surgical day	658	35.45	337	35.93	209	35.97	112	33.23
33. Monitoring vital parameters/FHR more times in a day	132	7.11	111	11.83	11	1.89	10	2.97
34. Complicated surgical wounds and/or drains controlled in the day	3	0.16	2	0.21	0	0.00	1	0.30
35. Administration I.V. more times in a day	93	5.01	59	6.29	22	3.79	12	3.56
36. Careful midwife/nursing control (four times in a day)	163	8.78	56	5.97	89	15.32	18	5.34
37. High blood pressure (systolic > 140 mmHg and/or diastolic >90 mmHg)	5	0.27	4	0.43	0	0.00	1	0.30
38. Temperature >38 °C in the last 48 h	1	0.05	0	0.00	1	0.17	0	0.00
39. Bleeding in act in the day, or in the last 24/48 h	45	2.42	25	2.67	2	0.34	18	5.34
40. Presence of contractile uterine activity in 1 h (3 contractions in 10')	5	0.27	4	0.43	1	0.17	0	0.00
41. Loss of amniotic fluid from external genitalia	6	0.32	2	0.21	4	0.69	0	0.00
42. CTG/AFI not satisfying reactivity criteria	7	0.38	5	0.53	0	0.00	2	0.59
Total of appropriate days of stay	1856	100.00	938	100.00	581	100.00	337	100.00
Inappropriate reasons								
43. Patient waiting surgical intervention/carrying out childbirth	26	17.22	18	21.18	0	0.00	8	34.78
44. Patient waiting diagnostic tests	45	29.80	33	38.82	0	0.00	12	52.17
45. Patient waiting specialist examination	15	9.93	8	9.41	5	11.63	2	8.70
46. Patient waiting tests results	21	13.91	3	3.53	18	41.86	0	0.00
47. Other causes depend to the Hospital (specifying)	7	4.64	3	3.53	3	6.98	1	4.35
48. Social-environmental causes	3	1.99	1	1.18	2	4.65	0	0.00
49. Other causes (specifying, especially if it's dealing with performance of medical/physical/rehabilitation therapy)	34	22.52	19	22.35	15	34.88	0	0.00
Total of inappropriate days of stay	151	100.00	85	100.00	43	100.00	23	100.00

Bold values signify maximum percentage.

Table 6. Distribution of criteria/reasons for the hospitalization.

Days stay 2nd–5th	2nd day		3rd day		4th day		5th day	
Code	*N*	(%)	*N*	(%)	*N*	(%)	*N*	(%)
Appropriate criteria								
29. Procedures in operating room or delivery room in the day	123	8.57	60	6.23	29	5.09	17	5.25
30. Procedures in O.R. in the next day, but requiring pre-operative consultations or valuations extra-routine	14	0.97	8	0.83	6	1.05	2	0.62
31. Medical/obstetrician observation at least three times	326	22.70	335	**34.79**	175	**30.70**	88	**27.16**
32. First post-partum/post-surgical day	476	**33.15**	111	11.53	58	10.18	33	10.19
33. Monitoring vital parameters/FHR more times in a day	121	8.43	77	8.00	55	9.65	42	12.96
34. Complicated surgical wounds and/or drains controlled in the day	14	0.97	15	1.56	5	0.88	5	1.54
35. Administration I.V. more times in a day	148	10.31	151	15.68	98	17.19	53	16.36
36. Careful midwife/nursing control (four times in a day)	169	11.77	171	17.76	117	20.53	65	20.06
37. High blood pressure (systolic>140 mmHg and/or diastolic >90 mmHg)	3	0.21	5	0.52	6	1.05	6	1.85
38. Temperature >38 °C in the last 48 h	2	0.14	2	0.21	4	0.70	2	0.62
39. Bleeding in act in the day, or in the last 24/48 h	29	2.02	20	2.08	11	1.93	5	1.54
40. Presence of contractile uterine activity in 1 h (3 contractions in 10')	1	0.07	2	0.21	0	0.00	1	0.31
41. Loss of amniotic fluid from external genitalia	4	0.28	3	0.31	3	0.53	3	0.93
42. CTG/AFI not satisfying reactivity criteria	6	0.42	3	0.31	3	0.53	2	0.62
Total of appropriate days of stay	1436	100.00	963	100.00	570	100.00	324	100.00
Inappropriate reasons								
43. Patient waiting surgical intervention/carrying out childbirth	27	6.16	175	**34.05**	0	0.00	12	4.11
44. Patient waiting diagnostic tests	45	10.27	58	11.28	0	0.00	29	9.93
45. Patient waiting specialist examination	15	3.42	55	10.70	5	11.63	8	2.74
46. Patient waiting tests results	34	7.76	5	0.97	18	41.86	11	3.77
47. Other causes depend to the hospital (specifying)	50	11.42	98	19.07	3	6.98	60	20.55
48. Social-environmental causes	4	0.91	117	22.76	2	4.65	4	1.37
49. Other causes (specifying, especially if it's dealing with performance of medical/physical/rehabilitation therapy)	263	**60.05**	6	1.17	15	**34.88**	168	**57.53**
Total of inappropriate days of stay	438	100.00	514	100.00	43	100.00	292	100.00

Bold values signify maximum percentage.

contrast to those found in the study by Poppa et al. in which the main reason of inappropriateness was ''other causes depending to the Hospital'' (94%).

The present research has some typical limits of the multicenter studies. The assessment of the CRs could be characterized by an information bias, because of the different reviewers engaged, even if a preliminary meeting was called. Indeed the Obstetric PRUO is an interesting evaluation tool but an effective application of the methodology requires a careful training of all the reviewers before starting the project (it is not by chance that the present study has been characterized by missing values, for inappropriateness reasons and criteria, in the data collection and analysis). On the other hand, in reviewing and assessing some CRs more than one criteria of appropriateness or inappropriateness could be adopted.

Moreover, the contents of the CR are not always easy to understand, consequently, to evaluate. However, the sample size, the independent review performed by two operators and the validated Obstetric PRUO tool encourage the reliability of the results and satisfy the aim of the project. Furthermore, in the present study the implementation of the OAEP in different Italian context confirmed its replicability.

Therefore, it is possible to conclude that the Obstetric PRUO is a practical and smart tool to carry out an evaluation of the CR and, consequently, to assess the appropriateness of hospital use both in terms of admission and days of hospital stay.

Declaration of interest

The ethical approval was given 17 June 2010. The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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