Cardiovasc Intervent Radiol (2009) 32:213–220
DOI 10.1007/s00270-008-9471-9

CLINICAL INVESTIGATION

Hospital Organization and Importance of an Interventional Radiology Inpatient Admitting Service: Italian Single-Center 3-Year Experience

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Received: 24 June 2008 / Accepted: 3 November 2008 / Published online: 18 December 2008

Abstract In June 2005 a Complex Operating Unit of Interventional Radiology (COUIR), consisting of an outpatient visit service, an inpatient admitting service with four beds, and a day-hospital service with four beds was installed at our department. Between June 2005 and May 2008, 1772 and 861 well-screened elective patients were admitted to the inpatient ward of the COUIR and to the Internal Medicine Unit (IMU) or Surgery Unit (SU) of our hospital, respectively, and treated with IR procedures. For elective patients admitted to the COUIR's inpatient ward, hospital stays were significantly shorter and differences between reimbursements and costs were significantly higher for almost all IR procedures compared to those for patients admitted to the IMU and SU (Student's *t*-test for unpaired data, $p < 0.05$). The results of the 3-year activity show that the activation of a COUIR with an inpatient admitting service, and the better organization of the patient pathway that came with it, evidenced more efficient use of resources, with the possibility for the hospital to save money and obtain positive margins (differences between reimbursements and costs). During 3 years of activity, the inpatient admitting service of our COUIR yielded a positive difference between reimbursements and effective costs of €1,009,095.35. The creation of an inpatient IR service and the admission of well-screened elective patients allowed short hospitalization times, reduction of waiting lists, and a positive economic outcome.

Keywords Inpatients · Hospitalization · Costs · Reimbursements

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Introduction

In most clinical contexts, patients requiring an interventional radiology (IR) procedure are usually admitted to an Internal Medicine Unit (IMU) or a Surgery Unit (SU), evaluated by clinical specialists, submitted to the appropriate clinical and radiological examinations, and then, after the consultation of an interventional radiologist, referred to the IR Department for treatment. This process is time- and resource-consuming for the hospital and a source of considerable discomfort for the patients, who first have to apply to the waiting list for admission to an IMU or a SU and who are submitted to the required procedure only after undergoing diagnostic imaging examinations and specialist consultations.

Moreover, in the last decade, other specialists such as cardiologists, vascular surgeons, urologists, and gastroenterologists, began increasingly acquiring interventional skills and treating their own patients, thus making the future role of the interventional radiologist uncertain.

Several authors [1–6] have emphasized that in order to maintain interventional procedures in the hands of interventional radiologists, clinical competence must be gained and the "interventional patient" must be managed entirely

by interventional radiologists from the time of diagnosis, through hospital admission and treatment, to postprocedural follow-up.

In June 2005 a Complex Operative Unit of IR (COUIR), consisting of an outpatient visit service, an inpatient admitting service with four beds, and a day-hospital service with four beds was installed at our department. The aim of our study is to demonstrate the importance of the development of IR as an independent specialty through the creation of COUIRs with their own hospitalization facilities where "interventional patients" may be admitted, evaluated, treated, and followed during the postprocedural period directly by interventional radiologists.

In the following paragraphs we describe the organization of the COUIR created at our department and the results obtained by the inpatient admitting service during 3 years of activity. Results concerning the activity of the COUIR's inpatient admitting service are presented in terms of numbers of elective patients treated, mean days of hospitalization, and costs and revenues and are compared to the results, expressed in terms of the same indicators, obtained for the IMU and SU.

Materials and Methods

Organization of the COUIR

The COUIR comprises an outpatient visit service, a day-hospital service with four beds, and an inpatient admitting service with four beds. The outpatient visit service is active for 5-h shifts twice weekly. Each shift is operated by one interventional radiologist and one radiology resident. Admission requires a physician's prescription, which may also be made by the medical staff of the COUIR. The objective of the outpatient service is to identify patients whose pathology can be treated by IR techniques, who do not present severe comorbidities (e.g., sepsis, unstable angina, gangrene), and who can therefore be admitted directly to the COUIR inpatient or day-hospital services.

Patients with severe comorbidities are usually admitted to either an IMU or a SU, where their comorbidities can be treated adequately, and the procedure is then performed at our department.

The day-hospital service is a daytime facility where minor interventional procedures that do not require an overnight hospital stay can be performed (e.g., varicocele sclerotherapy, PTA of arteriovenous fistulas for dialysis, biopsies). The four beds for day-hospital procedures are located in our department next to the angiographic suites.

The inpatient ward is a facility where elective patients undergoing interventional procedures requiring overnight hospitalization are admitted. The inpatient ward, with its four beds, is located next to the IMU. Paramedical services are provided directly by the IMU. Medical rounds are made three times a day.

Medical and Nursing Staff of the COUIR

The IR medical staff of our department is composed of 10 interventional radiologists and 6 radiology residents, while the IR nursing staff is composed of three nurses. The shifts of the outpatient visit service are operated by one interventional radiologist and one radiology resident. The inpatient ward is run by one interventional radiologist and two radiology residents. Continuous medical coverage is ensured by one interventional radiologist that is present at the hospital 24 hours a day. The paramedical services of the inpatient ward are provided by the IMU. The day-hospital service is operated directly by the staff of the angiographic suites. The angiographic suites are operated by two interventional radiologists, two radiology residents, and two nurses carrying out the IR procedures for the day-hospital and inpatient services of the COUIR, for the IMU and SU, and for other hospitals. When not directly involved in the outpatient and day-hospital services, inpatient ward, or angiographic suites, the IR medical staff is committed to the preprocedural and follow-up diagnostic imaging of the treated patients.

Preprocedural Evaluation in the COUIR

The preprocedural evaluation is performed by an interventional radiologist in the outpatient service of our COUIR by collection of a clinical history, execution of physical examination, and evaluation of laboratory analyses and radiological examinations. When required, pathologies are further investigated by additional radiological examinations (US, CT, MRI, etc.). Cases are discussed by consultation of other specialists when necessary. Medical therapy is installed or adjusted in accordance with the type of treatment that is planned. The pathologies for which complete patient management by the interventional radiologist is considered suitable, and admission to the inpatient ward of our COUIR is judged possible, are listed in Table 1.

Admission to the Inpatient Ward of the COUIR, Treatment, and Discharge

Patients are usually admitted to the inpatient ward the day preceding the procedure. A chest X-ray, a cardiologic visit with electrocardiogram evaluation, an anesthesiologic visit, and laboratory analyses are prescribed and an informed patient consent is obtained from each patient prior to the procedure.

Table 1 Pathologies selected for patient admission to the COUIR during the 3-year period

	Number of patients		
	Year 1	Year 2	Year 3
Vascular			
Carotid artery stenosis	141	125	136
Subclavian artery stenting	5	4	2
Renal artery stenting	37	33	27
Lower limb ischemia	24	25	32
TACE	27	23	25
SFA PTA/stenting	64	70	78
Iliac artery PTA/stenting	92	84	69
Iliac artery aneurysm stent-graft	8	5	5
Popliteal artery PTA/stenting	6	7	11
Extravascular			
Renal cyst sclerotherapy	20	13	12
Uterine fibroid embolization	4	5	3
Esophageal stenosis PTA/stenting	11	5	2
Skeletal-muscular			
Osteoporotic vertebral fractures	104	97	124
Neoplastic vertebral fractures	17	15	19
Intervertebral disc protrusion	49	58	49

While patients are admitted to the COUIR's inpatient ward with complete diagnostic imaging documentation obtained at the outpatient service, patients admitted to the IMU or SU undergo the diagnostic imaging examinations required for the IR procedure during hospitalization. The procedure is performed by the medical staff of the two angiographic suites. With the exception of skeletal-muscular procedures, a complete blood-profile evaluation is performed immediately after the procedure and at 6 and 12 h from the procedure to detect eventual bleedings. Specialist consults are requested when medical conditions that cannot be treated directly by the interventional radiologist occur. Patients admitted to the inpatient ward are usually discharged the day after the procedure with instructions for postprocedural medication and a schedule of the programmed follow-up examinations.

Patients

Between June 2005 and May 2008, a total of 5259 patients were treated in the angiographic suites of our department for vascular and extravascular pathologies. Of these patients, 1772 were elective patients hospitalized by the inpatient ward of the COUIR of our department. Among the patients admitted to the IMU and SU, 861 patients with no severe comorbidities and judged suitable also for admission to the inpatient ward of the COUIR were identified and defined as "elective." Three hundred six patients were admitted by the COUIR's day-hospital service. The remaining 2320 patients were not elective patients admitted to either the IMU, the SU or patients admitted to other hospitals and treated at our department.

A retrospective study, with full institutional review board approval and waiver of informed consent, was performed on the 2633 consecutive elective patients admitted to our hospital by either the inpatient admitting service of the COUIR (1772 patients) or the IMU and SU (861 patients), and treated at our department by IR procedures between June 2005 and May 2008. Patients hospitalized by the inpatient admitting service of the COUIR were first evaluated by the outpatient admitting service where they had been referred by vascular surgeons, neurologists, nephrologists, gastroenterologists, general practitioners, and others.

Study Endpoints and Statistical Analysis

Study endpoints were the assessment of significant differences between the mean days of hospitalization and costs for elective patients admitted to the inpatient ward of the COUIR versus the IMU or SU during 3 years of activity. All data are expressed as mean $\pm$ standard deviation. Categorical data are expressed as percentages. The mean days of hospitalization and the mean difference between reimbursements and costs (mean procedural yield) in elective patients undergoing IR procedures hospitalized by the COUIR's inpatient admitting service versus the IMU and SU at our hospital during the same time period were compared and statistical significance was calculated using Student's *t*-test for unpaired data. Statistical significance was established at $p < 0.05$. Input data and statistical analysis were performed using the Epi Info 3.4.4 software (CDC, Atlanta, GA, USA).

Cost Analysis

Hospital revenues, as represented by reimbursement fees obtained by the hospital from regional authorities, were calculated by adding the values of the diagnosis-related group (DRG) corresponding to each procedure/morbidity group. Costs consisted of procedural and hospitalization resources used.

Procedural resources were the amortization of the angiographic suite, the costs of the materials employed, and the engagement of the medical and paramedical staff. Amortization costs of the angiographic suite were calculated by adding the costs of the angiograph, of the automatic injector, the digital polygraph, the anesthesiology equipment, the laser printer, and the suite. The costs of the materials employed were calculated for each procedure according to the best retail price offered by suppliers. Costs

of the medical and paramedical staff of the angiographic suite were calculated considering the presence during each procedure of one interventional radiologist, one radiology technician, one nurse, and, when required, one anesthesiologist.

Hospitalization resources consisted of hospital bed-days, the cost of which also includes paramedical assistance. Costs of drugs were calculated referring to the hospital appraiser; specialist consults, laboratory analyses, preprocedural chest X-ray, and postprocedural radiological examinations were evaluated using regional tariffs. For patients admitted to the IMU and SU, the costs of preprocedural diagnostic imaging examinations performed after admission were also calculated. Per-patient medical costs were calculated considering continuous medical coverage at a physician-bed radio of 1:4 in the COUIR inpatient ward and of 1:20 in the IMU and SU. These ratios show the "economies of scale" of sharing medical staff when IR patients are admitted to an IMU or an SU. Costs of resource absorption for each procedure/morbidity group were calculated by adding procedure costs, hospital bed-day costs, medical resource costs, and additional costs. Total and mean differences between hospital revenues and costs for each procedure/morbidity group were calculated by subtracting the costs of the absorbed resources from the DRG reimbursements.

Finally, the total overall 3-year difference between reimbursements and costs, call it the hospital's margin, of the COUIR inpatient admitting service for elective patients undergoing IR procedures was calculated by adding the total differences obtained for the various procedure/morbidity groups.

Results

Hospitalization

For the 1772 patients admitted to the inpatient ward of the COUIR, mean hospitalization times ranged between a minimum of 2.25 days for nucleoplasty and a maximum of 4.00 days for uterine fibroid embolization, with a mean hospitalization time of 2.47 days. In the 861 patients admitted to the IMU or SU, mean hospitalization times ranged between a minimum of 3.00 days for esophageal PTA/stenting and a maximum of 9.54 days for lower limb ischemia, with a mean hospitalization time of 6.12 days.

With the exception of esophageal stenting and TACE, the mean hospitalization times were significantly lower for patients admitted to the inpatient ward of the COUIR compared to patients admitted to the IMU and SU. Mean hospitalization times for elective patients undergoing IR procedures admitted to the inpatient ward of the COUIR and to the IMU and SU of our hospital between June 2005 and May 2008 are reported in Table 2.

Cost Analysis

DRG codes and associated reimbursements for each procedure/morbidity group and their variations during the 3-year period are summarized in Table 3. Amortization and maintenance costs of the angiographic suite were estimated as €138.89 and €52.09 €/h, respectively. Costs of the staff of the angiographic suite were €40/h for the interventional radiologist, €50/h for the anesthesiologist, €30/h for the nurse, and €28/h for the radiology technician.

Hospital bed-day fees were determined by the hospital's administration as €350/day. With regard to hospitalization expenses for drugs, specialist consults, laboratory analyses, preprocedural chest X-ray examination, and postprocedural radiological examinations, a €150 daily expense per patient was estimated for both the COUIR and the IMU and SU. The costs of preprocedural diagnostic imaging examinations performed after admission in patients admitted to the IMU and SU were added to their hospitalization costs. Per-patient daily costs of medical assistance were €240 for the COUIR and €48 for the IMU and SU. The considerably higher cost of medical assistance for the COUIR can be ascribed to the "isolation" of the few beds for IR patients, which made the burden of medical assistance heavier. As a matter of fact, contrary to the IMU and SU, in this case it is not possible to benefit from the synergy of sharing costs with other patients. The cost of medical assistance for the COUIR could be further reduced by increasing the number of beds.

The remunerability of a procedure depended on its low total patient costs (procedure and hospitalization costs) and/or its high DRG reimbursement. Contrarily, the low or negative economic yield of a procedure depended on the high total patient costs and/or low DRG reimbursement. For procedures carried out on patients admitted to the COUIR's inpatient ward, vertebroplasty, renal artery stenting (PTRS), lower-limb ischemia and iliac artery PTA/stenting were the most remunerable procedures, while for carotid artery stenting (CAS), iliac artery aneurysm stent-graft placement, esophageal PTA/stenting, nucleoplasty, uterine fibroid embolization, and popliteal artery PTA/stenting, resource absorption costs were higher than DRG reimbursement, thus resulting in an economic "deficit." On the other hand, in patients admitted to the IMU and SU, with the exception of vertebroplasty in neoplastic vertebral fractures, PTRS, TACE, and renal cyst sclerotherapy, all procedures were associated with a negative economic margin for the hospital. This result is due to the long hospitalization times, which more then offset the advantage due to the "economies of scale" in

Table 2 Mean hospitalization times for elective patients admitted to the inpatient ward of the COUIR and to the IMU and SU

Procedure	COUIR: hospital bed-days, mean (total)	COUIR: total number of patients	IMU and SU: hospital bed-days, mean (total)	IMU/SU: total number of patients
Carotid artery stenosis	2.26 ± 0.54 (912)	402	6.57 ± 1.21 (1682)*	256
Renal artery stenting	2.27 ± 0.32 (221)	97	5.30 ± 0.73 (228)*	43
Lower limb ischemia	3.67 ± 0.81 (298)	81	9.54 ± 1.05 (1641)*	172
TACE	3.76 ± 0.48 (282)	75	4.03 ± 1.12 (226)	56
SFA PTA/stenting	2.42 ± 0.29 (515)	212	3.74 ± 0.78 (326)*	87
Iliac artery PTA/stenting	2.35 ± 0.35 (576)	245	4.21 ± 0.62 (312)*	74
Iliac artery aneurysm stent-graft	2.33 ± 0.26 (42)	18	4.85 ± 0.47 (34)*	7
Subclavian artery PTA/stenting	2.27 ± 0.13 (25)	11	5.33 ± 0.25 (16)*	3
Popliteal artery PTA/stenting	2.95 ± 0.18 (71)	24	4.72 ± 0.51 (241)*	51
Uterine fibroid embolization	4.00 ± 0.65 (48)	12	5.66 ± 1.24 (17)*	3
Esophageal PTA/stenting	3.11 ± 0.31 (56)	18	3.00 ± 0.93 (21)	7
Renal cyst sclerotherapy	2.68 ± 0.13 (121)	45	3.55 ± 0.42 (64)*	18
Vertebroplasty				
Osteoporotic	2.27 ± 0.21 (738)	325	5.03 ± 0.35 (131)*	26
Neoplastic	2.50 ± 0.19 (128)	51	6.43 ± 0.24 (296)*	46
Nucleoplasty	2.25 ± 0.08 (351)	156	3.08 ± 0.82 (37)*	12
Total	2.47 ± 0.73 (4384)	1772	6.12 ± 1.64 (5272)	861

* Significant difference between groups ($p < 0.05$; Student's *t*-test for unpaired data)

Table 3 Diagnosis-related group (DRG) codes and associated reimbursements for each procedure/morbidity group and their variations (in italics) during the 3-year period (Lazio Regional Reimbursement)

	Year 1		Years 2 & 3	
	DRG	Reimbursement (€)	DRG	Reimbursement (€)
Vascular procedures				
Carotid artery stenosis	5	4618	*5*	*4736*
Subclavian artery stenosis/occlusion	5	4618	*5*	*4736*
Renal artery stenosis	479	4256	*315*	*5781*
Iliac artery stenosis/occlusion	479	4256	*479*	*3889*
Iliac artery aneurysm	111	6900	*479*	*3889*
SFA stenosis/occlusion	479	4256	479	*3889*
Popliteal artery stenosis/occlusion	479	4256	479	*3889*
Infrapopliteal artery stenosis/occlusion	478	8190	478	*5911*
Hepatocarcinoma nodules	203	4256	203	*3519*
Extravascular procedures				
Uterine fibroids	365	4597	*365*	*4597*
Renal cysts	332	2100	*305*	*4856*
Esophageal stenosis	155	4560	155	4560
Skeletal-muscular				
Neoplastic vertebral fractures	233	6694	233	*7678*
Osteoporotic vertebral fractures	234	3714	234	*3307*
Intervertebral disc protrusion	215	3600	*500*	*2683*

Table 4 Revenue and cost analysis of the procedures performed in patients admitted to the IMU and SU

Procedure	DRG reimbursement: year 1 (€)	DRG reimbursement: years 2 & 3 (€)	Mean resource cost	Mean difference, reimbursement–resource cost
Carotid artery stenting	4618	4736	6624.18 ± 490.03	−1927.51 ± 490.03*
Renal artery stenting	4256	5781	4756.23 ± 306.86	516.44 ± 306.86*
Lower limb ischemia	8190	5911	8367.68 ± 726.17	−1697.01 ± 726.17*
TACE	4256	3519	3452.67 ± 391.41	312.00 ± 391.41*
SFA PTA/stenting	4256	3889	4439.52 ± 390.23	−428.19 ± 390.23*
Iliac artery PTA/stenting	4256	3889	4354.24 ± 263.06	−342.91 ± 263.06*
Iliac artery aneurysm stent-graft	6900	3889	8448.99 ± 334.28	−3956.32 ± 334.28*
Subclavian artery PTA/stenting	4618	4736	5256.78 ± 309.00	−560.11 ± 309.00*
Popliteal artery PTA/stenting	4256	3889	5087.06 ± 363.92	−1075.73 ± 363.92*
Uterine Fibroid embolization	4597	4597	5450.48 ± 339.10	−853.48 ± 339.10*
Esophageal PTA/stenting	4560	4560	5674.06 ± 391.48	−1114.06 ± 391.48*
Renal cyst sclerotherapy	2100	4856	2277.43 ± 162.25	1659.90 ± 162.25
Vertebroplasty				
Osteoporotic	3714	3307	4203.73 ± 239.54	−761.06 ± 239.54*
Neoplastic	6694	7678	5146.28 ± 298.97	2203.72 ± 298.97*
Nucleoplasty	3600	2683	4142.40 ± 354.11	−1153.73 ± 354.11*

* Significant difference versus patients admitted to the COUIR's inpatient ward ($p < 0.05$; Student's t-test for unpaired data)

the medical assistance of patients on units with a higher number of beds.

A significantly higher margin was observed for all procedures, with the exception of renal cyst sclerotherapy, in the inpatient ward of the COUIR compared to the IMU and SU. For the 1772 elective patients admitted to the COUIR's inpatient ward over the 3-year period, the total DRG reimbursements summed to €7,536,129, and since the total costs were equal to €6,527,033.65 a positive difference between reimbursements and costs of €1,009,095.35 was obtained.

The revenue and cost analysis of the procedures performed in patients admitted to the inpatient ward of the IMU and SU and the significance of the differences versus patients admitted to the COUIR's inpatient ward ($p < 0.05$; Student's t-test for unpaired data) are reported in Table 4. The differences between total costs and total revenues in patients admitted to the inpatient ward of the COUIR are listed in Table 5.

Discussion

In 1968 Charles Dotter warned, "If we don't assume clinical responsibility for our patients, we will face forfeiture of our territorial rights based solely on imaging equipment others can obtain and skills others can learn" [4]. In 1999 the American College of Radiology stated the importance of clinical patient care in the realm of IR in the "Support of Clinical Patient Management by Vascular and Interventional Radiologists" [7]. The creation of a cardiovascular radiology admitting service for well-screened elective patients was first reported by Kinnison et al. in 1985 [3]. Patients were under the care of a cardiovascular radiology fellow and a staff physician. The authors emphasized that the main advantage of such a service was the possibility of achieving a broadened patient referral base, improved follow-up data, and rapid evaluation and treatment, allowing short hospitalizations.

The functioning of a COUIR requires the creation of an outpatient visit service. Normally, to obtain a consultation by an interventional radiologist, a general practitioner must first refer his or her patient to a clinician, thus losing direct control of the patient [3]. Moreover, this type of organization is extremely time-consuming considering that the patient must first obtain an appointment with the clinician, who will then request a consultation with the interventional radiologist. In particular, the service provided by the outpatient visit service allows direct contact between the general practitioner and the interventional radiologist, thus reducing the time required to obtain a consultation. Appointments for admission to our outpatient visit service are usually arranged within a week.

Table 5 Differences between total costs and total revenues for patients admitted to the inpatient ward of the COUIR

Procedure	Total DRG reimbursement: year 1 (€)	Total DRG reimbursement: years 2 & 3 (€)	Total revenues (€)	Total resource costs (€)	3-year total difference, revenues–resource cost
Carotid artery stenting	651,138	1,236,096	1,887,234.00	1,901,288.75	−14,054.75
Renal artery stenting	157,472	346,860	504,332.00	3,584.83	500,747.17
Lower limb ischemia	196,560	336,927	533,487.00	444,384.47	89,102.53
TACE	114,912	168,912	283,824.00	276,288.30	7,535.70
SFA PTA/stenting	272,384	575,572	847,956.00	811,690.34	36,265.66
Iliac artery PTA/stenting	391,552	595,017	986,569.00	851,125.10	135,443.90
Iliac artery aneurysm stent-graft	55,200	38,890	94,090.00	130,288.00	−36,198.00
Subclavian artery PTA/stenting	18,605	28,416	47,021.00	43,760.51	3,260.49
Popliteal artery PTA/stenting	25,536	70,002	95,538.00	102,053.52	−6,515.52
Uterine fibroid embolization	18,388	36,776	55,164.00	58,946.76	−3,782.76
Esophageal PTA/stenting	50,160	31,920	82,080.00	112,036.03	−29,956.03
Renal cyst sclerotherapy	42,000	121,400	163,400.00	99,391.59	64,008.41
Vertebroplasty					
Osteoporotic	386,256	730,847	1,117,103.00	936,135.85	180,967.15
Neoplastic	113,798	261,052	374,850.00	165,251.73	209,598.27
Nucleoplasty	176,400	287,081	463,481.00	590,807.88	−127,326.88
Total			7,536,129	6,527,033.65	1,009,095.35

The outpatient visit service is also essential for direct patient/interventional radiologist contact. In most clinical scenarios, the interventional radiologist is called by a clinician for imaging consultation on "a case," and when an interventional procedure is decided on the interventional radiologist barely sees the patient before the procedure is performed. This approach creates a sense of anxiety in the patient relative to the lack of complete confidence in the operator and makes the interventional radiologist, from a professional point of view, a mere executor of the procedure.

We believe that direct general practitioner/interventional radiologist and patient/interventional radiologist contact is necessary for appropriate procedural planning and increases the interventional radiologist's professional esteem among colleagues. This is also the basis for the broadening of the patient referral base, which is crucial for assuring constant patient flow for the day-hospital and the inpatient admission services.

Patients presenting to the outpatient visit service are usually referred by other specialists, general practitioners, or radiologists. At our department more than 200 US, 50 Doppler US, 150 CT, and 100 MR examinations are performed daily and a considerable number of patients are referred for further evaluation to the outpatient visit service of the COUIR. It is also important to note that a considerable number of patients presenting to the outpatient visit service are well informed regarding the different treatment options for their disease and come with the explicit request to be treated by IR procedures.

We believe that the development of the clinical skills necessary for direct patient management requires a clinical organization that must begin during the residency training program. At our department, radiology residents committed to IR receive 1 year of training in internal medicine while following the activities of the COUIR. By the end of their clinical training period, residents have gained sufficient clinical proficiency to cope with the most frequent tasks related to the care of elective patients.

Despite the few beds at our inpatient admitting service, we obtained high patient volumes, thanks to the significantly shorter hospitalization times (hospital bed-days) for most of the procedures. Waiting-list times for our inpatient admitting service usually range between 1 and 3 weeks. This is considerably shorter than the waiting lists for elective patients at the IMU or SU of our hospital (5–8 weeks). Considering that patients are usually treated within 3 weeks from the arrangement of the initial IR consultation, we can assert that the creation of the COUIR considerably streamlined the disease management process. This substantially reduced the discomfort and anxiety perceived by the patients, who normally, before arriving at

the angiographic table, have undergone several specialist consultations. The creation of the COUIR substantially improved the feasibility of patient follow-up, which is performed at the outpatient visit service. We believe that a well-organized follow-up is important for both the patient and the interventional radiologist. Aside from its clinical aspects, a methodical follow-up by the same physicians who performed the procedure provides the patient with a sense of tranquility, knowing that the disease is being taken care of.

The significantly shorter hospitalization times obtained for patients admitted to the COUIR's inpatient ward can be ascribed mainly to the extensive preprocedural evaluation performed at the outpatient visit service. Differently from the IMU or SU, when patients are admitted to the COUIR's inpatient ward, all necessary imaging examinations, specialist consults and drug therapy adjustments have been accomplished and the patients are ready for treatment. Patients admitted to the IMU and SU, before an IR treatment is planned, must undergo the necessary diagnostic imaging examinations and specialist consults, thus significantly prolonging hospitalization times and resource consumption.

The significantly higher yields observed for all procedures, with the exception of renal cyst sclerotherapy, on the inpatient ward of the COUIR compared to the IMU and SU, with a total yield of €1,009,095.35 during 3 years of activity, can be attributed mainly to the short hospitalization times and to the appropriate preprocedural evaluation of elective patients in the COUIR.

Our data demonstrate how the reorganized disease management process introduced by the COUIR can also result in the optimization of consumption of hospital resources, giving hospitals a positive margin (revenues > costs). These data may thus provide further incentives to hospital administrations for the creation of IR units with inpatient admitting facilities.

The acquisition of clinical skills by interventional radiologists and the creation of IR services with their own hospitalization facilities are essential for the development of IR as a separate speciality. The creation of an IR inpatient admitting service can result in improved patient disease management and a reduction of hospitalization times and of hospital expenses.

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