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MINISYMPOSIUM: SPECIALIST PEDIATRIC RADIOLOGY — DOES IT ADD VALUE?

Sustainability of paediatric radiology in Italy

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Abstract
Italy is the sixth most populous country in Europe and has the second highest average life expectancy, reaching 79.4 years for men and 84.5 for women. However, Italy has one of the lowest total fertility rates in the world: in 2018 it was 1.3 births per woman, with the population older than 65 comprising more than 30%, and those younger-than-19 less than 15%. Older people are the main concern of the Italian health system. Weighted coefficients for the allocation of funds favour older adults. As confirmed by our study, paediatric radiology is expensive, and the reimbursement based on Italian adult rates is not sufficient. The negative impact on the budget discourages the diffusion of paediatric radiology both in the private practices that provide services paid for by the state government and in the public hospitals. The 501 paediatric hospital units in Italy are not homogeneously distributed throughout the national territory. Furthermore, in Italy there are 12 highly specialised children's hospitals whose competences were defined in 2005 by the Ministry of Health. Paediatric radiology is not included among the highly qualified specialties. The quality gap in paediatric radiology between children's hospitals and general hospitals, the latter often without paediatric radiologists, is evident in daily practice with misdiagnoses and investigations not carried out.

Keywords Health care costs · Management · Paediatric radiology · Radiology

Introduction

In Italy, paediatric radiology is not recognised as a sub-specialty, although there are 12 highly specialised paediatric hospitals. The Ministry of Health defined their competencies in 2005. Paediatric radiology has not been included among the essential specialties. The lack of a specific qualification has noticeable effects not only on the career of individual radiologists but also on the economic balance sheet. As a result of paediatric radiology not being economically advantageous, it is neglected by local administrations and may be unattractive to radiologists. To assess the state of this situation, we performed an economic analysis starting from the cost evaluation of the Imaging Department of Bambino Gesù Children's Hospital in Rome, which is the largest in Italy and has a private provider agreement with the Italian government.

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Organisation and funding

The increased time needed for examinations and patient turnover are well-known causes of additional costs of paediatric radiology, as well as the direct and indirect costs of anaesthesia (we discuss this point later). Formula-based tariffs are insufficient to cover the true costs. In Italy, imaging departments have a direct income only from outpatients, but coding and classification systems used to list outpatient services make no distinction between adults and children. Furthermore, concerning inpatients, the costs charged to the clinical departments are usually defined by the same national tariffs nomenclature for outpatient specialist care. This approach is not correct because inpatients involve a more significant commitment because of their disease complexity and critical condition. Paradoxically, the lower the complexity of the hospital, the higher the sustainability of radiology.

The high cost discourages providers from delivering adequate services, not only private partners that provide services paid for by the State with a real budget made up of income and expenditures, but also public hospitals in which fund allocation is limited to a spending threshold and "virtual" revenues are a benchmark. The budget is mainly aimed at controlling expenditures (drugs, equipment, medical devices) and allocating staff on the basis of "workloads," whose calculation is much more quantitative (number of admissions, outpatient services, accident and emergency visits, and so on) than qualitative. For this reason, many leading institutions of great clinical, academic and research value do not have an internal paediatric radiology service.

The departments dedicated exclusively to paediatric radiology with a volume of examinations higher than 50,000/per year and equipped with advanced imaging equipment are: 4 in the north, 2 in the centre, 1 in the south. They are located inside the largest children's hospitals that treat most of the complex paediatric diseases. They are not necessarily located where there is the greatest need.

Fourteen of 20 Italian regions have a children's hospital or at least radiologists dedicated to paediatrics within adult hospitals with access to a full range of imaging equipment. This highlights the great inequity of access to such services where a large number of children and their families have no access to specialised services. Altogether, about 680,000 children (0–14 years) cannot benefit from adequate paediatric radiology services. Universities, which have an agreement with the National Health System, do not have any internally structured paediatric radiologists.

The current funding system seems ill designed to fill this inequity. Italy is the sixth most populous country in Europe (about 60 million inhabitants) and has the second-highest average life expectancy, reaching 79.4 years for men and 84.5 for women (84.0 years of life expectancy at birth, both genders). Infant mortality is 2.2 (infant deaths per 1,000 live births). Deaths of children younger than 5 years are 2.6 (per 1,000 live births). Italy's health care system is a regionally based national health service that provides universal coverage mostly free of charge at the point of delivery.

The primary source of financing is derived from national and regional taxes, supplemented by co-payments for pharmaceuticals and outpatient care. The state of health of the Italian population is in line with that of other European Union countries. However, despite this general evaluation, disparities are reported among the 20 Italian regions. In almost all demographic and health indicators, marked regional differences reflect the economic and social imbalance between the north and south of the country. A high number of indicators on the performance of regional health care systems clearly show that the national health system is fragmented into 20 different systems. The Italian health system is highly decentralised, with most organisational powers governed by the regions and that have somewhat limited powers at the national level. The State has a full control of the definition of the benefits package (essential levels of health care). However, there is evidence that the actual provision of these services varies significantly across regions, as shown by the significant flow of patients moving from the south-central regions to the central-northern ones to receive care. Concerning paediatrics, Italy has one of the lowest total fertility rates in the world: in 2018 it was 1.3 births per woman, far below the replacement level of 2.1 (replacement-level fertility is the level of fertility at which a population exactly replaces itself from one generation to the next). In developed countries, replacement-level fertility is considered 2.1 children per woman) [1–4].

Italy currently spends less than the Organization for Economic Co-operation and Development (OECD) average on health care concerning its gross domestic product (GDP) — 9.2% compared to the OECD average of 9.3%. Public sources make up 78.2% of total health care spending (~ 6.6% of GPD), with private spending, mainly in the form of out-of-pocket payments (17.8%), accounting for the remainder. These out-of-pocket payments are mainly made for diagnostic procedures (laboratory tests and imaging) in the form of cost-sharing for services covered by the national health system or direct payments outside it. Italy's National Health Service is financed through a national fund. After its total value has been established, it is then allocated to every region. The general allocation mechanism is defined by the Italian "quota capitaria" (capitation quota; capitation is the payment of a pre-determined amount by the health service providers for each registered person assigned to them, for a period of time, regardless of whether that person seeks assistance). From a technical point of view, the allocation mechanism is constituted by two steps. Briefly, the first step consists in identifying essential levels of care, and the second in defining the criteria to be applied to each region's population. The increasing demand for assistance for older people is the primary driver influencing the allocations in a country where the population older than 65 comprises more than 30% and those younger than 19 less than 15% (Fig. 1). The Italian capitation system, at first glance, seems comparable to the English one, with the difference that the latter is highly centralised. In Italy, regions have the exclusive authority for execution-level planning and delivery of health care. For instance, Tuscany set out to keep the system heavily centralised, with most hospitals depending on local health authorities' control and only a few becoming independent public hospital institutions. Conversely, Lombardy in 1998 opted for a full-fledged experiment in which all hospitals and specialist services are delivered by independent public or private providers. The region's leading hospitals are free to negotiate financing terms with local health authorities, although they are based on the quality of services provided [5, 6].

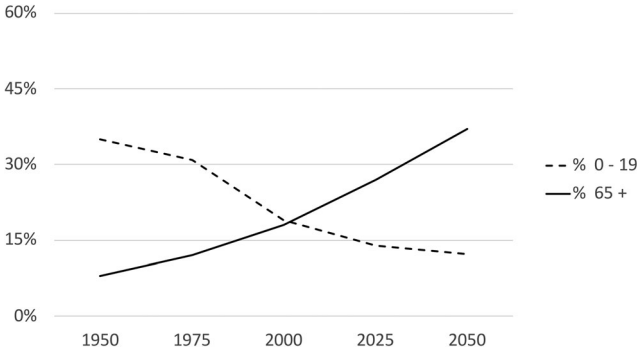

Fig. 1 Italian population trend. The proportion of people over 65 years old is increasing while the proportion of people younger than 19 years old is decreasing

The national system's payment for hospital care (ordinary and day hospital treatments) is based on diagnosis-related group (DRG) tariffs, although it is generally complemented by other payment methods (lump sum or global budget), while outpatient care is reimbursed using a tariff per unit of care (Table 1). There are considerable inter-regional variations in the prospective payment system adopted by each region, such as how the fees are set, which services are included, and the tools employed to influence patterns of care [5, 7–15]. In all regions, a portion of funding is administered outside the prospective payment system (e.g., financing of specific functions, such as emergency departments, teaching programmes, organ transplants, blood and tissue banks). All regions have mechanisms for cutting tariffs once a spending threshold for the hospital sector or even each provider is reached, in order to contain costs and offset incentives to increase admissions.

In the public hospitals DRGs are a benchmark, not an economic evaluation instrument. In the private centres, when care is aggregated into a single bundled payment (DRG), the payer pays a single bill, providing greater predictability and ease of payment. The payments flow to the central finance department of the hospital, which allocates the revenue to the providers of care within the bundle. The margin of preservation among the multiple providers necessitates a revenue distribution system that aligns with costs. How can the health system ensure that the negotiated rate of its contract to manage a full range care to each patient is sufficient to support a diverse blend of expenses with an adequate margin? How can a radiology department be ensured that the transferred revenue covers the cost of high-quality care? With the aim of analysing all these points, we developed a model for assessing the actual costs of a paediatric radiology department.

Cost estimates

Managing costs begins with their measurement. We prefer a bottom-up approach that allows providers to estimate costs related to resource utilization involving many health care workers and managers [12, 16–27].

We employed time-driven activity-based costing (TDABC) [27] and estimated the radiology costs in the Imaging Department of Bambino Gesù Children's Hospital (Ospedale Pediatrico Bambino Gesù - OPBG) in Rome (Italy), to compare reimbursement tariffs [28]. TDABC uses two proven management tools: process mapping from industrial engineering and activity-based costing from accounting. For each phase of the care process, we estimated the time needed to carry out each activity. Subsequently, we calculated the costs of the necessary resources for each step by determining the cost per unit of capacity; by multiplying this coefficient by the required activity time for each phase of the process and adding the cost of each component, we calculated the total cost of the process [28].

The "capacity cost rate" per minute for each clinical activity involved in the treatment cycle refers to the full cost of providing a resource divided by the amount of time that resource was available for each productive work. The capacity cost rate was calculated per personnel, space and equipment.

Personnel costs include compensation, office costs, technology, training, supervision, and other indirect expenses incurred to support each singular subject. Space and equipment costs include depreciation or rental costs, space occupied, utilities, consumables, maintenance and repair.

Our cost estimate is based on a document drafted by the Italian Society of Medical Radiology model for assessing the performance of radiologic teams [29], carried out to measure the radiologists' activity and diagnostic equipment. The proposed model also contains an approach to determine the costs of other professional figures that are indispensable for the functioning of an imaging department, such as nurses, auxiliaries and administrative staff (Table 2).

Through software for monitoring the activities of the various professional figures in our hospital, we established

Table 1 Essential level of health care funded by the Italian government is allocated per capita (41%) and by age-weighting (59%), resulting in funding that favours the older population

	<1 y	1–4 y	5–15 y	15–24 y	25–44 y	45–64 y	65–74 y	>75 y
Inpatients	0.389	0.221	0.279	0.390	0.650	1.156	2.177	2.074
Outpatients	3.122	0.366	0.226	0.363	0.528	0.930	2.079	2.906

The numbers represent weighting coefficients for age classes

Table 2 Personnel costs (€) for some examinations (cost per minute times average examination time)

Examination	Radiologist cost per examination	Nurse cost per examination	Radiographer cost per examination	Personnel costs per examination
Abdominal CT	33	10	19	65
Chest radiograph	7	2	16	27
Skeletal survey	31	2	28	63
MRI of brain and brainstem	77	17	41	138

the values in minutes relating to the various professional profiles, taking into account the timeframes relating to performance and not to patients [30–37]. The economic analysis of the Imaging Department was implemented according to the typical path of patient care [12, 38]. In particular, the health activities carried out were conventional radiology, fluoroscopy, ultrasound, CT, MRI and nuclear medicine [39].

After estimating every expense per minute for direct and indirect costs, it was possible to calculate the total costs for each examination of the imaging department. Direct costs are those expenses directly associated with goods or services, such as materials, labour and manufacturing supplies. Indirect costs are the general expenses that keep the business operating, such as rent, utilities and general office expenses. Total costs were calculated in two steps: first, all direct costs; second, all indirect costs.

According to the rates currently applied for reimbursements provided by the Commissioner Decree n. U00313/13 "Approval of the Regional Tariff Nomenclature for Outpatient Specialist Assistance Services", the current tariff is at a lower level than the real expenditure of the department. The cost of each process is higher than the level of reimbursements provided by the national health system. More generally, our analysis highlights the main problems relative to the examinations carried out under sedation (MRI and CT) and bedside sonography (Figs. 2 and 3) [23].

Discussion

The present report provides cost transparency for our Imaging Department and the services it provides. Time-driven activity-based costing offers the possibility of evaluating the care process and allows assessment of the value of each patient's care. As a result of the analysis, health management could better organise the future costs for the department in light of the reimbursements by the national health system [12].

In this analysis, we provide a detailed view of direct and indirect costs in the imaging field. We applied time-driven activity-based costing methodology in our imaging department to evaluate the costs [24–26]. According to Kaplan et al. [12, 23, 27], this method also considers the cost of the effective time of procedures, e.g., the total minutes for activities including training, meetings and other support activities. Our results confirm that the cost of each health activity carried out by a paediatric imaging department is higher than the level of reimbursements provided by the national health system.

In paediatric radiology, more nurse time is needed. The job description in an adult hospital includes verification of laboratory parameters, undressing, connection to infusion pumps for examinations with contrast media, control of post-examination conditions, etc. In paediatrics, support to children and families is also crucial. Examination time is increased for not-collaborating patients, up to sedation (not included in the procedural terminology codes).

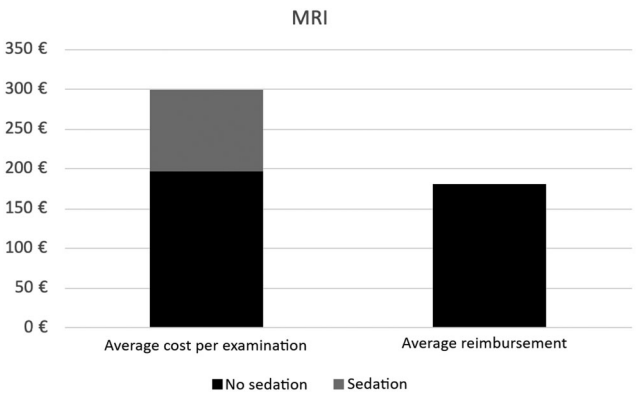

Fig. 2 The provider (hospital) cost of a paediatric MRI scan is higher (by 8%) than the reimbursement negotiated for an adult outpatient. Examinations (CT and MRI) performed under sedation increase the cost by 40%

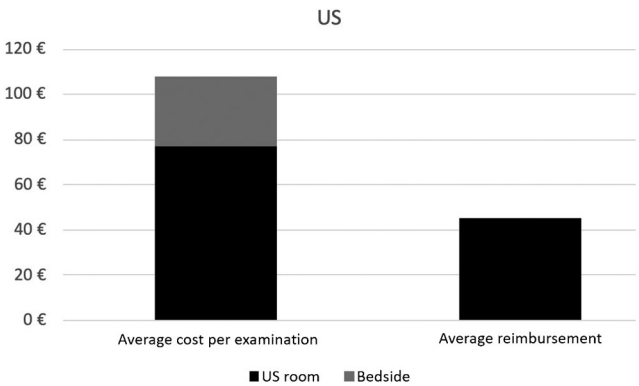

Fig. 3 The provider (hospital) cost of a paediatric ultrasound scan is higher (by 42%) than the reimbursement negotiated for an adult outpatient. Examinations performed bedside increase costs by 58%

Time spent looking after children (e.g., to conduct mock MRI, to provide films during the examinations) and the higher number of bedside sonographies (in Italy, 80% of the hospitalised acute patients are younger than 1 year) contribute to high costs of paediatric radiology. Furthermore, relatively new examinations, such as whole-body MRI, cardiac CT, cone-beam CT and EOS X-ray imaging, are not included in the Italian codes. Another easily overlooked source of costs for patients and payers is imaging overutilization. While imaging study demands are made by physicians and not by radiology providers, radiologists cannot avoid these costs.

The Italian Public Health Service requires that all children benefit from an identified primary care provider, depending on the child's age. Italian paediatricians related to the National Health Service work in private offices, providing primary care to patients from birth to 16 years of age. Paediatricians act as gatekeepers for the system, assessing children's needs, prescribing treatments, ordering diagnostic procedures, and referring patients to specialists and hospitals.

Secondary care is performed in paediatric hospital units, which admit children 0–18 years of age. The 501 paediatric hospital units in Italy are not homogeneously distributed throughout the national territory. To comply with the cost-containment policies issued in the years following the 2008 global economic turmoil, the most recent national health plan has identified a further rationalization of the expenses, which also impacts paediatric hospital care. Such measures of cost containment include a further general reduction of investments in child health care by reducing the number of paediatric hospital units. Conversely, the importance of medical technology has generally grown over time. Paradoxically, the number of MRI units, CT scanners and positron emission tomography (PET) units is continually rising, at least doubling over the last 10 years to become one of the highest per capita in the European Union, albeit with significant regional variability.

Additionally, in Italy there are 12 highly specialised children's hospitals whose competences were defined in 2005 by the Ministry of Health. Paediatric radiology is not included among the highly qualified specialties [40]. The quality gap in paediatric radiology between super-specialised centres and paediatric units in general hospitals, often without paediatric radiologists, is reflected in daily practice by misdiagnoses and investigations not carried out (e.g., acting in defensive medicine, not performing MRI to avoid sedation, nor CT to prevent radiation).

The survival of paediatric radiology, even in high-complexity centres, is linked to obtaining an increase in remuneration from the internal clinical departments, provided that the hospital administration accepts internal rebalancing as a real economic income. Indeed, upstream of this, hospitals should develop a political and financial operation to increase the revenue of clinical departments for select complex activities. The lack of such an action might lead to inadequate paediatric radiology even within the wealthiest regions because paediatric outpatients are a minority.

Financing in the area of paediatric radiology, in the most advanced centres, can also be obtained through research funds and adequate remuneration in clinical trials. Paediatric radiologists' activity isolated in an adult structure is more complicated. In case of lack of radiologists, at the level of costs attributable to a single episode of care, an essential source of waste includes medical procedures that cost more than the value they create and imaging studies that are not indicated by the patient's condition. Teleradiology could be an opportunity. Heterogeneity of regional structures limits the diffusion. Besides, clinicians have the funds to create networks but tend to exclude radiologists. Computerised networks connecting physicians, primary care paediatricians, hospitals and territorial services to facilitate communication among health care professionals and improve continuity of care must include paediatric radiologists.

Conclusion

In Italy, public health does not sufficiently support paediatric radiology. This has led to an uneven development. So far, paediatric radiology development is strictly related to the presence of children's hospitals born from the intuition of benefactors, kept alive in the name of a tradition that cannot be disregarded. These structures allow the maintenance of a high-level paediatric radiology school. The spread of paediatric radiology in regions without a tradition of centres dedicated to complex paediatric pathologies is difficult. The cost of specialised personnel and management of examinations hampers any development. Recently, we have witnessed greater interest in paediatric radiology by young radiologists. The risk for those who do not remain in specialised centres is that they have little space where neonatal radiology is performed by neonatologists and sonography by paediatricians.

Compliance with ethical standards

Conflicts of interest None

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