

ORGANIZATIONAL CAPABILITIES IN HEALTH CARE INSTITUTIONS: A MULTISOURCE TERRITORIAL STUDY¹

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Abstract. The Italian debate on territorial healthcare is currently focused on the implementation of various measures under the National Recovery and Resilience Plan (PNRR), particularly Mission 6 on Health, aimed at enhancing human resources and services. This paper examines, from an ex-ante perspective, the potential capability of regional health institutions using an input-output framework applied to personnel classified by socio-demographic characteristics. The analysis draws on two key official data sources: the Annual Accounts from the Ministry of Economy and Finance, and ISTAT Multipurpose Household Survey. A comparison is made between the most recent available data (2022) and that from 2012. The authors introduce a novel composite index of organizational functionality (IFO-Health), which aggregates 10 distinct, minimally correlated, indicators related to the quality of human capital. The findings reveal a persistent disparity in responsiveness of territorial healthcare, particularly in southern regions of Italy, where weaknesses in human capital are relevant. These areas often correspond with regions under Health Deficit Recovery Plans and report lower levels of patient satisfaction with medical and nursing care.

1. Premise: objectives and general framework

The potential capability of territorial health care institutions (National Health System - NHS) is a multifaceted phenomenon. In this study, it is analyzed according to the input/outcome model, which has been applied to personnel classified by socio-demographic characteristics. The study of the quality of human capital in health institutions helps to measure the potential capability of these administrations to respond to demographic and technological changes and transformations and it is a valuable aid for policy makers. This is the context for the analysis of a new organizational strategy towards a balanced development of the quality of human capital, with the aim of enhancing and strengthening the skills and knowledge of public health care employees (Inapp, 2021), due to the effects of an ageing population on turnover planning and the definition of educational supply. The input component is explored through a composite index that measures the potential

¹ The paper has been jointly written by all the authors but § 1 and 8 can be attributed to all the authors, while § 2 to A.P.M. Mirto, § 3 and 7 to F. Gaudio, § 4 to F. P. Rizzo, § 5 to A. Pareto, § 6 to D. Maiolino. Elaborations by Comic software and ArcGis maps have been realised by F. P. Rizzo.

functionality of health care institutions. The composite index has already been tested on municipality according to the same input/outcome model (Istat, 2024). However, it should be noted that the *one-size-fits-all model* may not always be applicable, and that it should be considered the specificities of the compartment, the territories, and the historical context.

2. Policy needs and health evaluation

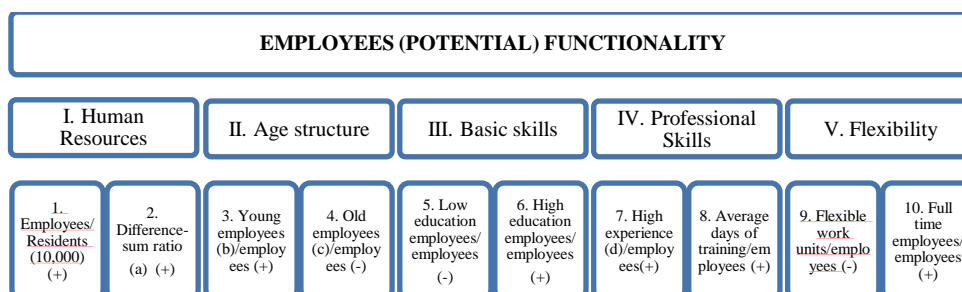
Over the past fifty years evaluation systems - in the public and in the private sector - have undergone a process of incremental evolution which has broadened the scope of analysis from a mainly economic-financial focus to a multidimensional assessment, to an inter-organisational vision (Nutti S. et al., 2021). This promotes the use of methodologies and the collection of information regarding performance to provide all stakeholders with appropriate evidence concerning needs, used resources and achieved results (Walshe and Rundall, 2001). The selected indicators generally cover a plurality of evaluation dimensions, such as population health status, efficiency and sustainability, communication and processes, regional health strategies, internal (employee) evaluation, external (user) evaluation, and clinical care evaluation. This is the context for this contribution, which focuses on one of the organisational components such as human capital. In 2022 the NHS was focused on attempting to capitalise on the opportunities presented by the PNRR investments (S. Anna, 2023). The renewal of regional healthcare systems has long been a subject of national political and scientific debate. The capability of health institutions forms the basis of both planning and evaluation processes. Its analysis contributes to the ongoing argue on ensuring accessible, sustainable and resilient healthcare personnel (Agenas, 2023). In the context of the fundamental principles that underpin the establishment of the NHS (namely, universality, equality and equity), the national intervention in the field of health acts in favour of specific targets of the population characterised by a vulnerable socio-economic situation and contributes to egalitarian access to services (PCM, 2023). Within the Framework of Italy's Partnership Agreement on Cohesion Policy 2021-2027 the National Health Equity Programme (NHEP) was approved. In accordance with the NHEP, the capacity of regional health systems in at least seven regions of the country (Basilicata, Calabria, Campania, Molise, Puglia, Sardegna and Sicilia) should be enhanced. Compared to the rest of the country, these regions have lower levels of compliance with nationally defined standards (LEA, Essential Levels of Care) and greater financial and organisational difficulties in the management of the health service. The following analysis considers NHS bodies, which, unlike other sectors of the public service, are not subject to shift hiring limits but to an expenditure constraint, where and further, more

stringent limitations are laid down in the specific programmes of regions subject to financial recovery plans (MEF, 2024). The operational programmes for the reorganisation and strengthening of the Regional Health Service (later called Deficit Recovery Plans-DRP) came into being with the 2005 Budget Law (311/2004) and were attached to agreements entered by the Ministers of Health and Economy and Finance with the Regions. There are seven regions currently subject to DRP (Abruzzo, Calabria, Campania, Lazio, Molise, Puglia e Sicilia), Liguria and Sardegna concluded their DRP at the end of the first three-year period 2007-2009; Piemonte at the end of the three-year period 2013-2015.

3. Ex-ante evaluation of human resources: framework, individual indicators and regional profiles

From an ex-ante evaluative perspective - hence, at a probabilistic and potential level - a composite index, designated IFO-Health, has been devised to assess the functionality of National Health Service (NHS) institutions. IFO-Health permits the examination of the dimensional and socio-professional adequacy of employees, the primary input variable of these services, and the relationship between these variables and the perceived outcome of the client (satisfaction).

Figure 1 - Structure of the IFO-Health index.



(a) $(recruited-terminated)/(recruited+terminated)$; (b) <40 years; (c) >60 years; (d) >20 years

The framework, which has recently been applied to the case of other public institutions (Istat, 2024; Mirto A.P.M., Gaudio F., Abate F., 2023), enhances ten typical proxies of the quality of services to people, with available data provided by the Ministry of Economy and Finance (MEF) Annual Account² (Figure 1). The framework is inspired by the input-outcome model and considers the strategic value of personnel in the working process of services. The quantitative endowment, skills

² Census survey on public administrations carried out since 1992 by the Ragioneria Generale dello Stato.

and ability to perform sequences of actions functional to the resolution of a socio-technical problem constitute the key element for good organisational functioning (Gori E., Vittadini G., 1999; Gaudio F., 2009). The work considers the most recent available year (2022) by comparing it to 2012.

Table 1 – Staff of health institutions by region. 2022 (absolute and % values).

Region	Employees	%	Number per 1,000 residents	Part-time Employees (%)
Piemonte (b)	55,136	8.1	13.0	9.2
Valle d'Aosta	2,138	0.3	17.4	8.2
Lombardia	104,495	15.3	10.5	10.6
Liguria	23,825	3.5	15.8	6.2
Trentino-Alto Adige	17,317	2.5	16.1	31.8
Friuli-Venezia Giulia	20,609	3.0	17.3	6.8
Veneto	63,292	9.3	13.1	11.4
Emilia-Romagna	67,949	10.0	15.3	6.1
Toscana	54,976	8.1	15.0	3.7
Umbria	11,787	1.7	13.8	2.4
Marche	19,700	2.9	13.3	4.3
Lazio (a)	48,502	7.1	8.5	2.1
Abruzzo (a)	14,400	2.1	11.3	1.9
Molise (a)	2,794	0.4	9.6	1.5
Campania (a)	47,404	7.0	8.5	0.4
Puglia (a)	38,892	5.7	10.0	1.4
Basilicata	6,452	0.9	12.0	1.9
Calabria (a)	17,841	2.6	9.7	0.6
Sicilia (a)	43,262	6.3	9.0	1.0
Sardegna (b)	21,084	3.1	13.4	2.0
Italy	681,855	100.0	11.3	6.2

(a) Regions subject to Deficit Recovery Plans; (b) Regions exited from Deficit Recovery Plans.

Source: elaborations on MEF – Annual Account.

In 2022, 681,855 people were employed in healthcare, representing 20.8% of the total in the public sector. This denotes a slight increase over 2012 (+1.2%), which can be attributed to the injections aimed at containing the impact of the pandemic. The health sector is characterised by a high concentration of personnel in territorial units, with 185 institutions accounting for 90.3% of the workforce³. It also exhibits a considerable degree of differentiation in professional profiles⁴. The analysis does not address these specificities; instead, it focuses on diachronic trends and, above all, on territorial differences. This is also in consideration of certain relevant specificities connected to the Deficit Recovery Plans and to the effects on personnel due to financial constraints. In quantitative terms, the contraction in staff numbers recorded until 2019 is mainly ascribable to the regions subject to such discipline (MEF-RGS,

³ The remaining share: Scientific Care Institutes (20 units, 4.7% of employees); University Polyclinics (10; 2.2%); Environmental Protection Agencies (19; 1.2%); Others (55; 1.6%).

⁴ Nursing staff 41.6%; technicians 18.6%; doctors 15.8%; rehabilitation staff 11.9%; administrative staff 9.6%; others 5.7%. See Ministero della Salute (2022).

2024). These regions also present the lowest staff per 1,000 residents and low part-time quotas (Table 1).

4. Main results at the level of individual indicators

An examination of the basic indicators set by the Framework in relation to human resources in the health sector reveals a few important findings and trends (Table 2).

Table 2 – Individual indicators (with polarity) and trends – 2022 (*).

Regione	1. Staff per inhabitants (x10,000)	2. Difference-sum ratio (+)	3. % Young employees (< 40 years) (+)	4. % Old employees (> 60 years) (-)	5. % Low education (-)	6. % High education (+)	7. % High experience (+)	8. Average days of training (+)	9. % Flexible work units (-)	10. % Full time employees (+)
	Piemonte (b)	129.7	0.09	21.7	14.3	16.1	44.0	46.6	1.3	7.7
Valle d'Aosta	173.6	-0.21	21.5	9.8	11.9	46.6	39.3	0.4	13.3	91.8
Lombardia	104.7	0.04	26.1	11.5	15.4	48.4	44.2	0.8	5.2	89.4
Bolzano/Bozen	168.3	0.06	21.7	7.8	41.6	35.5	48.9	3.1	17.5	58.1
Trento	153.3	-0.03	29.9	8.2	28.8	45.4	40.1	0.1	6.2	79.1
Veneto	130.5	0.03	27.5	10.7	25.8	48.0	42.1	0.4	2.3	88.6
Friuli-Venezia Giu.	172.6	-0.11	27.5	10.4	21.1	46.1	29.2	0.6	9.5	93.2
Liguria (b)	158.0	0.22	20.5	15.9	18.0	41.9	42.1	1.7	7.6	93.8
Emilia-Romagna	153.1	0.10	29.5	10.8	10.5	53.6	32.8	2.2	5.9	93.9
Toscana	150.1	-0.01	22.3	15.2	13.5	51.1	38.1	2.9	4.4	96.3
Umbria	137.6	-0.06	22.4	17.2	4.1	65.2	37.5	1.2	8.4	97.6
Marche	132.7	0.00	21.6	14.7	9.3	53.6	35.8	0.3	9.4	95.7
Lazio (a)	84.8	0.19	19.9	18.6	9.5	73.2	39.7	1.6	10.2	97.9
Abruzzo (a)	113.2	0.16	17.7	20.8	9.7	58.7	41.8	0.6	21.5	98.1
Molise (a)	96.1	0.17	13.4	27.6	0.4	67.3	37.1	0.8	11.5	98.5
Campania (a)	84.5	0.29	22.2	24.3	28.2	38.6	36.0	4.6	9.2	99.6
Puglia (a)	99.5	0.00	18.8	20.0	14.1	49.4	27.3	0.8	13.8	98.6
Basilicata	120.0	-0.10	14.7	25.5	6.5	68.4	28.3	1.2	10.4	98.1
Calabria (a)	96.6	-0.02	29.3	25.4	30.0	43.4	32.3	0.2	8.1	99.4
Sicilia (a)	89.9	-0.11	12.8	26.1	13.6	52.3	39.0	1.0	19.4	99.0
Sardegna (b)	133.6	-0.24	20.2	21.5	34.5	58.8	34.7	0.3	13.2	98.0
Italia	115.6 ↑	0.03 ↑	23.1 ↑	15.9 ↑	17.2 ↓	50.7 ↑	38.6 ↓	1.4 ↓	8.5 ↑	93.8 ↑

(*): The font color, in the regions, indicates the trend of the 2022 ranking compared to that of 2012: red if decreasing, green if increasing, black if stationary; (a) Subject to Deficit Recovery Plans; (b) Exited from Deficit Recovery Plans.

Source: elaborations on MEF - Annual Account.

Over the period 2012-2022, the ratio of employees to residents per 10,000 inhabitants (ind. 1) increases from 111.7 to 115.6. The regions in the Centre-North have a higher relative endowment than those in the South. In recent years, characterized by the unblocking of recruitment in the public sector (MEF-RGS, 2024), positive effects have been reported in the health sector (as well as in education), both in terms of endowment and, consequently, in terms of age composition. Regarding the first aspect, in 2022 the difference-sum ratio (ind. 2) takes a slightly positive value (0.03), reversing the sign of 2012 (-0.15). This dynamic implies a slight change in the age structure of the workforce compared to 2012. The share of employees under 40 years of age (ind. 3) increased (from 17.4% to 23.1%), with a higher incidence in the north-eastern regions, except for Alto Adige, and a lower one in the south, except for Calabria (from 9% in 2012 to 29.3%). The share of employees aged over 60 also increased over the decade (ind. 4), from

6.2% to 15.9%, with high shares in the Mezzogiorno and rather low shares in the northern regions (especially the North-East). During the decade under review, the share of employees with a low level of education (ind. 5) fell from 22% in 2012 to 17.2% in 2022. The best picture is found in the central regions. At the same time, the proportion of employees with a high level of education (ind. 6) is generally increasing: in 2022, more than one in two employees in the health sector will have a tertiary level qualification (36.4% in 2012). The highest increase will take place in the central regions, and in Lazio this share will be almost 3/4. An unfavorable trend can be observed in the dimension of professional skills. The unblocking of turnover and the positive trend reported by the surplus index have led to a tendency for the share of employees with more than 20 years' experience (ind. 7) to fall from 42.4% in 2012 to 38.6% in 2022, particularly in many southern regions. In 2022, the average number of days of training (ind. 8) also decreases, presumably also as a result of the restrictions imposed by the pandemic, from around 1.8 days in 2012 to almost 1.5 days in 2022. The dynamics of employment flexibility are mixed. The ratio of flexible work units to the total number of permanent employees shows a significant increase (from 4.8% to 8.5%) over the period considered. The regions with the highest values are in the south, those with the lowest in the north, except for Bolzano and Valle d'Aosta. On the other hand, as regards the proportion of full-time employees (ind. 10) - which has slightly increased at national level (from 91.9% to 93.8%) - the southern regions have consistently higher values than the central and northern regions, in contrast to the trend in other public sectors (Istat, 2024).

5. The composite index: methodology and robustness

The composite index was constructed using the Adjusted Mazziotta-Pareto Index (AMPI), which is a partially compensatory aggregation function (Mazziotta and Pareto, 2016). Such a choice is advisable whenever adequate performance on any of the individual indicators is considered critical to overall performance.

The most original aspect of this index is the method of normalization, the so-called “constrained min-max method” (Mazziotta and Pareto, 2021). It normalizes the range of individual indicators in a similar way to the classic min-max method but uses a common reference (base value) that makes it possible to define a ‘balancing model’ (i.e. the set of values that are considered balanced). In this way, it is possible to compare the values of the units both spatially and temporally with respect to a common reference that does not change over time. Let us consider the matrix $\mathbf{X}=\{x_{ijt}\}$ with 21 rows (Italian regions), 10 columns (individual indicators), and 2 layers (years) where x_{ijt} is the value of individual indicator j , for region i , at year t . A normalized matrix $\mathbf{R}=\{r_{ijt}\}$ is computed as follows:

$$r_{ijt} = 100 \pm \frac{x_{ijt} - x_{j0}}{\max_{it}(x_{ijt}) - \min_{it}(x_{ijt})} 60$$

where $\min_{it}(x_{ijt})$ and $\max_{it}(x_{ijt})$ are, respectively, the overall minimum and maximum of indicator j across the two years (goalposts), x_{j0} is the Italy average in 2012 (base value) for indicator j , and the sign \pm depends on the polarity of indicator j .

Denoting with M_{r_i} , S_{r_i} , cv_{r_i} , respectively, the mean, standard deviation, and coefficient of variation of the normalized values for region i , at year t , the composite index is given by:

$$AMPI_{it}^- = M_{r_i} - S_{r_i} cv_{r_i}$$

where:

$$M_{r_i} = \frac{\sum_{j=1}^{10} r_{ijt}}{10} \quad S_{r_i} = \sqrt{\frac{\sum_{j=1}^{10} (r_{ijt} - M_{r_i})^2}{10}} \quad cv_{r_i} = \frac{S_{r_i}}{M_{r_i}} .$$

The version of AMPI with a negative penalty was used, so that an unbalance among indicators has a negative effect on the value of the index.

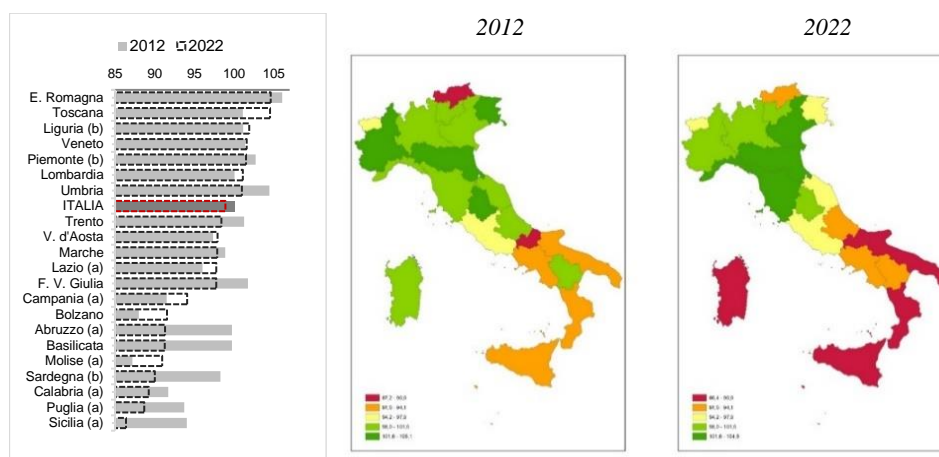
The robustness of the index was assessed through an influence analysis aimed at studying whether and to what extent the ranking of the Italian regions changes when a single indicator is removed from the initial set.

Starting from the 10 individual indicators, 10 replications were performed by eliminating a different indicator each time and calculating the values of the composite index based on the remaining 9 indicators. For each replication, the ranking of the Italian regions was created and the absolute difference of rank between the position in the original ranking and the position in the ranking corresponding to the 9 indicators was calculated for each region. Finally, the Mean Absolute Difference of rank (MAD) was obtained for each indicator removed. In 2012, the MAD varies between 0.38 (high education) and 2.10 (young employees) positions, while in 2022 it varies between 0.48 (high education) and 2.29 (high experience). Moreover, the standard deviation of MAD is 0.537 in 2012 and 0.516 in 2022. Therefore, the variability of the rankings appears to remain constant over time.

6. Composite index: main evidence and territorial gaps

The composite index IFO-Health offers an analytical overview of the set of individual indicators covered by the operational model. In order to facilitate geographical and temporal comparisons, the 2012 Italy value (100) has been indexed.

At the diachronic level, a general downward shift in the (potential) functionality of the NHS workforce over the decade under consideration is confirmed. This finding is consistent with what has been observed with a similar approach in other areas of the public sector (Istat, 2024). In particular, the decline in the national average value (from 100 in 2012 to 98.9 in 2022) can be attributed to the significant reduction observed in 12 regions, with a particularly pronounced decline evident in much of southern Italy (Figure 3). Concurrently, a clear divergence can be observed between the IFO values in the Centre-North – particularly in the main northern regions, which are above the national average and generally progressing – and those in the South, all of which are far from the average and generally in regression despite the existence of deficit recovery plans. Within this framework, there are a few exceptions, which will be mentioned later. Nevertheless, these observations do not alter the substance of a dualistic model at a territorial level, as showed by the related cartographic evidence (Figure 3), which demonstrates a notable strengthening over the decade in question. As already pointed out in the analysis of the individual indicators, most influential in the widening of the gap between North and South are the increase in the ratio of employees to residents in the North compared to the South, the indicator relating to the share of employees over 60 years of age (significant growth in the South) and the ratio of flexible work units to total permanent employees, which grew more in the South. Upon closer examination, several noteworthy elements emerge. In 2022, Emilia-Romagna is confirmed as the most virtuous region, although its IFO score has declined slightly. Toscana has demonstrated clear progression, advancing six positions since 2012 and becoming the second-best performer. At the opposite end of the distribution is Sicilia, which has experienced notable regression. In regions with a more pronounced potential functionality gap in terms of employees compared to the national average, all cases affected by Deficit Recovery Plans stand out. The Province of Bolzano, however, has improved its ranking, moving from 20th to 14th. Among the regions exhibiting a positive trend are Lazio, Campania and Molise, which have experienced the highest growth rate (3.8). Conversely, the remaining regions of Abruzzo, Calabria, Puglia and Sicilia have demonstrated discrepancies, which appear to be worsening.

Figure 3 – IFO-Health by region.

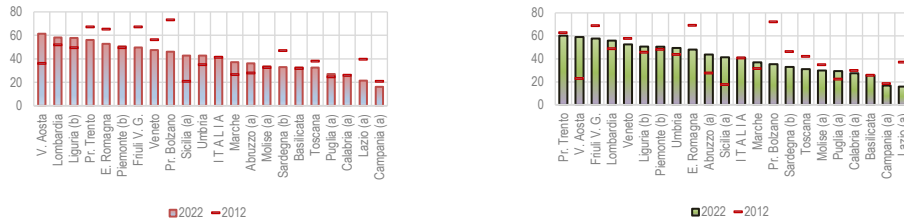
Source: Elaborations on MEF - Annual Account.

In Mezzogiorno, Basilicata, Abruzzo and Sardegna which are already very critical cases, all recorded a contraction of more than 8 points. Other regions such as Sicilia (- 7.7), Puglia (- 5.1) and Calabria (- 2.5) helped confirmed that the negative trend with the gap compared to the regions of the North has widened further. Significant reductions were also observed in Umbria (- 3.5), Friuli-Venezia Giulia (- 4.0) and the Province of Trento (- 2.9).

7. Composite index and perceived outcome (satisfaction)

Patient satisfaction is a relevant outcome dimension: it is the perceived quality resulting from a subjective assessment between what was expected and what was received (or perceived as such). It is functional for continuous improvement, subject to certain limitations related to its subjective nature (Ovretveit J., 1992; Pagano A., Vittadini G., 2004). Despite a critical context marked by the pandemic emergency, in Italy there has been a very slight increase over ten years in the number of people who are very satisfied with the assistance they receive, which exceeds 4 out of 10 cases both in the medical field (from 41.3% to 41.7%) and in the nursing field (from 40.4% to 41%, Figure 4).

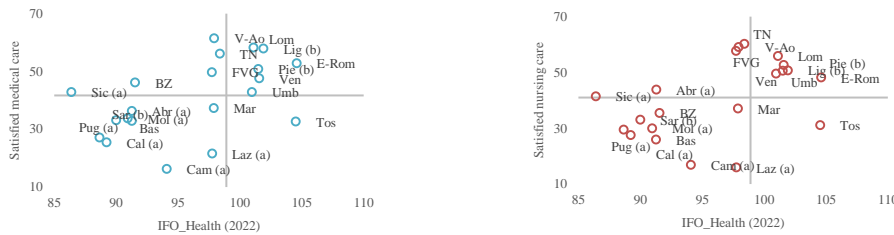
Figure 4 - People very satisfied with medical care (left) or nursing care (right), by region (*). 2012 and 2022 (% values).



(*) Persons with at least one hospitalisation in the three months preceding the interview; (a) Regions subject to Deficit Recovery Plans; (b) Regions exited from Deficit Recovery Plans.

Source: Elaborations on MEF - Annual Account.

Figure 5 - Organisational functionality (IFO-Health) and persons highly satisfied with medical (left) and nursing (right) care (*) by region. 2022 (absolute and % values).



(a) Regions subject to Deficit Recovery Plans; (b) Regions exited from Deficit Recovery Plans

Source: elaborations on MEF data and Istat, Multipurpose Survey - Aspects of Daily Life.

Satisfaction decreases from North to South, with some significant exceptions: Tuscany - below the national average and in decrease - and the Province of Bolzano, in visible retreat. Excluding Sicilia (where satisfaction improves) and Abruzzo in part, the problematic regions are all long-standing subject to recovery plans: Puglia (since 2010), Calabria (since 2009, now a commissioner), Lazio (since 2007) and Campania (since 2007). The Province of Trento, Valle d'Aosta, Lombardia and Liguria are virtuous cases. The Province of Bolzano, and the rest of the north-east, report a regression on which the pandemic event may have had an influence, which hit those territories hard during the onset and most acute phase (ISTAT-ISS, 2022). Similarly to what was observed in the case of the municipalities (Istat, 2024), there is a visible link between the IFO-Health index and patient satisfaction, while is quite evident in certain contiguous groupings of the South and the Islands, on the one hand, and of the

Centre and above all of the North, on the other, with a certain consistency between the two performance areas considered (Figure 5). The main southern regions, except for Sicilia, tend to be in the third quadrant (low satisfaction and low functionality), both for the medical sector (Figure 5, left) and for the care sector (Figure 5, right). On the other hand, the main regions of central and, above all, northern Italy, which are characterised by high functionality, also report virtuous levels of satisfaction and generally place themselves in the first quadrant. Apart from a few exceptions (above all Lazio, Sicilia and Toscana), there is a rather clear differentiation on a territorial basis, a kind of dual model that can be extended to the position of each region regarding the deficit reduction plans: the regions that are still subject to these measures converge in the group characterised by low satisfaction and low functionality.

8. Final remarks and future perspectives

During the last decade, the decline in the IFO-Health national average value can be attributed to the significant reduction observed in 12 regions, with a particularly pronounced drop evident in much of southern Italy - which are far from the average and generally in regression despite the existence of Deficit Recovery Plans.

Future perspectives of this contribution are related to the deepening of the context in which the analysis is carried out, considering the end of the pandemic, PNRR measures and the consequences for employment in health care institutions (MEF, 2024; CE, 2022). One of the main improvements in the model considers the time series analysis of employment by type of contract, gender and qualification to study the development and improvement of skills and capacity for workforce planning at national and regional level. Finally, the study of all model components (process, output and outcome) is a crucial issue also to evaluate the segment of health institutions by type of public body (Istat, 2024).

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