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# Quality of hospital care and clinical outcomes: a comparison between the Lombardy Region and the Italian national data

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*Parole chiave: Assistenza sanitaria basata sul valore; esiti clinici;AGENAS; PNE; settore privato*

**Abstract**

***Background.*** *Improving the quality and effectiveness of healthcare is a key priority in health policy. The emergence of the COVID-19 pandemic has exerted considerable pressure on hospital networks, requiring unprecedented reorganization and restructuring actions. This study analyzed data from the Italian National Outcomes Program to compare some volumes and outcomes of public and private accredited hospitals in the Lombardy Region with national data.*
***Study design.*** *Observational study.*
***Methods.*** *A thorough examination of hospital outcomes between 2019 and 2021 was conducted, considering 45 volume indicators and 48 process and outcome indicators, comparing Lombardy with other Italian regions and public versus private accredited hospitals.*
***Results.*** *In 2020, Italy and Lombardy experienced a considerable reduction in overall hospital admissions, with Lombardy showing a deeper decline (21.3% compared with 16.0% in Italy). In 2021, both experienced a partial recovery, especially marked in the Lombardy region (+7.3%, compared with national data). Focusing specifically on the private sector in Lombardy, a recovery of +9.3% in hospitalization was observed. In the analysis of clinical outcomes, Lombardy outperformed the national average for 63% of the indicators in 2020 and 83.3% in 2021.*
***Conclusions.*** *The study shows the continuing decline in volumes compared to 2019 (pre-COVID), the excellent performance of hospitals in Lombardy and a relevant contribution for the volumes and the quality of outcomes of private accredited hospitals.*

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## Introduction

The evaluation, in quality and effectiveness, of provided services is mandatory for any organization aiming to improve its performances, and the Italian National Health Service (SSN) is no exception (1-2).

Over the last 20 years, several programs have been carried out to develop a tool capable of evaluating the performance of services provided by public and private affiliated hospitals. The "Mattoni Outcome Project" and the subsequent "Progr.Es.Si", aimed to evaluate the outcomes and process indicators in different clinical and surgical areas. In 2012, the Italian Ministry of Health mandated, through DL 135/2012, the National Agency for Regional Health Services (AGENAS) to develop the National Outcomes Evaluation Programme, called PNE (3).

The PNE assesses effectiveness in practice, clinical-organizational appropriateness, safety, and equity of access to care by studying the variability (comparative analysis) of processes and outcomes of healthcare provided by the SSN within the scope of Essential Levels of Assistance (Livelli Essenziali di Assistenza - LEA) (4). The PNE assessments are based on using current information flows available at the national level. The sources include the Databases of Hospital Discharge Records (SDO) (5) related to accredited public and private Italian healthcare institutions, the Emergency-Urgency (EMUR) information system (6), and the National Tax Registry for verifying the vital status of patients.

The outbreak of the COVID-19 epidemic in Italy on 21 February 2020, marked by the first confirmed case in Codogno, Lombardy, has had an extraordinary pressure and impact on the delicate balance within the country's hospitals. Lombardy was one of the first places in the world to be so drastically affected, and guidelines for the management of COVID-19 were largely non-existent. A Regional Emergency Committee (REC) was set up and the regional health system was reorganized. This reorganization included suspending elective surgical activity to increase the number of available ward beds and redirect the time of healthcare staff (7). The crisis has prompted a major reassessment of health priorities (8).

Despite the completeness of the data there is a selected number of published research papers and reports based on this data (9-19) as the Program has been designed primarily to support local administrators, health policymakers, hospital CEOs and health professionals in healthcare quality improvements (4).

This paper considered the 2019-2022 outcomes data with a particular focus on Lombardy, Italy's largest region, which has traditionally provided high-quality health services to around 10 million inhabitants, in line with all the principles of universal health coverage (UHC) (20-21). In total, the Region has 132 acute care hospitals, of which 78 are public and 54 are private accredited hospitals (both profit and non-profit). In addition, there are 20 research hospitals known as IRCCS (Istituto di Ricovero e Cura a Carattere Scientifico), consisting of 5 public and 15 private institutions, all accredited with the National Health Service. THE IRCCSs, which belong to a national network approved and financed by the Ministry of Health, have the additgional task of performing high level resesrch in the field they are particularly expert (cardiovascular, cancer, etc). Overall, the existing hospital infrastructure consisted of 55% (83 out of 152) public and 45% private facilities (22).

The main objective of this study is to analyze the Italian National Outcomes to compare hospital admission volumes and clinical outcomes in the Lombardy region with those of other Italian regions in the years 2019-2021, considering both public and private healthcare providers. Additionally, another objective is to evaluate differences of indicators in public and private accredited hospitals.

## Methods

The study used a subset of 48 process/outcome indicators out of a total of 73 defined by AGENAS to assess the quality of hospital facilities. In addition, 45 of the 83 volume indicators were considered relevant by the Scientific Committee of Sanità Futura Foundation, considering the volume of cases treated by hospitals and their impact on the health of citizens. The indicators were distributed among the 8 clinical areas as follows:

Box 1. Distribution of Outcome and Volume indicators by clinical area.

| Clinical areas | Outcome indicators | Volume indicators |
|---|---|---|
| Cardiovascular | 14 | 10 |
| Cerebrovascular | 2 | 3 |
| Digestive | 2 | 2 |
| Musculoskeletal | 10 | 6 |
| Malignant tumours | 13 | 18 |
| Perinatal | 4 | 2 |
| Respiratory | 2 | 1 |
| Urogenital | 1 | 3 |
| **Total** | **48** | **45** |

To obtain a complete picture of the consequences of the COVID-19 pandemic, an analysis of the evolution of the volumes of hospital admissions in the three years (2019, 2020 and 2021) was carried out. We used national data and data from the Lombardy Region to make appropriate comparisons; moreover, in Lombardy, the volumes of public hospitals were compared with those of private accredited hospitals. To ensure the homogeneity of the comparison between regions, adjusted data were taken into consideration for all indicators, i.e., those resulting from the adjustment procedure of the "raw" data adopted by AGENAS (4). In this paper, the classification of hospitals into public hospitals and private accredited hospitals followed the criteria adopted by the PNE: public hospitals include hospitals integrated with the NHS (National Health Service), university hospitals, research hospitals, public foundations, and public research bodies; private accredited hospitals include private University hospitals, hospitals accredited by USLs (Local Health Authorities), private IRCCS, private Foundations, hospitals managed by religious bodies.

Statistical analysis was conducted using the chi-square test, and significance was defined at a threshold of 0.05.

## Results

*Volume Indicators*

After the relevant reduction of hospital admissions in 2020, a partial recovery in volumes was observed in 2021 for the 45 indicators considered, both in Italy and in Lombardy. The decrease in the volume of admissions was greater in Lombardy than in Italy in both 2020 and 2021 (21.3% against 16.0% in 2020 and 14.0% against 11.8% in 2021). However, in 2021, Lombardy showed a greater capacity to recover, with an improvement of 7.3% compared to the national average of 4.2%. The reduction over the two years was observed, to varying degrees, in all clinical areas and for all indicators, except for pulmonary embolism. Excluding the perinatal sector, where the decrease in the number of births was in line with the trend observed for many years, the decrease in the number of hospital admissions in Italy ranged from a minimum of 3.1% (oncology sector) to a maximum of 45.0% (respiratory sector), for which the only indicator available concerned chronic obstructive pulmonary disease (COPD).

The volume of hospital admissions recorded in the different clinical areas in Italy and Lombardy over the three years is shown in Table 1. The deviations recorded in 2020 and 2021 compared to 2019 are indicated. The specific volume indicators are also presented in Appendix-Table 1A.

Table 1. Variation in the volume of hospital admissions 2019-2021: comparison Italy-Lombardy.

| Indicator | Italy | | | | | Lombardy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | Deviation | | 2019 | 2020 | 2021 | Deviation | |
| | | | | 20/19 | 21/19 | | | | 20/19 | 21/19 |
| Cardiovascular area | 463,091 | 371,885 | 398,440 | -19.7% | -14.0% | 79,346 | 63,495 | 68.996 | -20.0% | -13.0% |
| Cerebrovascular area | 95,292 | 83,987 | 84,242 | -11.9% | -11.6% | 14.556 | 12.836 | 13.198 | -11.8% | -9.3% |
| Digestive area | 110,962 | 79,780 | 92,915 | -28.1% | -16.3% | 18,859 | 11,989 | 14,819 | -36.4% | -21.4% |
| Musculo-skeletal area | 291,585 | 247,674 | 363,123 | -15.1% | 25.2% | 72,318 | 52,174 | 63,797 | -27.9% | -11.8% |
| Oncology area | 208,932 | 188,624 | 202,392 | -9.7% | -3.1% | 45,041 | 36,152 | 40,584 | -19.7% | -9-9% |
| Perinatal area | 417,144 | 404,135 | 398,506 | -3.1% | -4.5% | 72,881 | 69,334 | 68,670 | -4.9% | -5.8% |
| Respiratory area | 102,475 | 60,640 | 56,317 | -40.8% | -45.0% | 17,013 | 9,685 | 9.324 | -43.1% | -45.2% |
| Urogenital area | 230,178 | 176,109 | 185,515 | -23.5% | -19.4% | 33.151 | 22,114 | 24,480 | -33.3% | -26.2% |
| Total hospitalisations | 1,919,659 | 1,612,834 | 1,781,450 | -16.0% | -11.8% | 353,165 | 277,779 | 303,868 | -21.3% | -14.0% |

*Outcome Indicators*

Table 2 shows statistically significant findings regarding the number of cases treated and the mean adjusted (ADJ) clinical outcomes in Italy and Lombardy for the years 2020 and 2021. In 2020, Lombardy exhibited better outcomes in 16 out of 23 significant indicators (70%). In 2021, the Lombardy region demonstrated better outcomes in 22 out of 25 indicators (88%).

Table 3 shows the number of cases treated, ADJ clinical outcomes and ADJ average outcomes for public and accredited private hospitals in the Lombardy region in 2021. Out of 48 outcomes, 36 (75%) appear to be

Table 2. Number of cases treated and mean adjusted clinical outcomes in Italy and Lombardy for the years 2020 and 2021: statistically significant findings comparing Italy and Lombardy.

| Ref | Indicator | Italy | | | | Lombardy | | | | p Value 2020 | p Value 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n. cases | | ADJ | | n. cases | | outcome ADJ | | | |
| | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | | |
| 1 | Lower limb arteriopathy 3rd and 4th degree mortality at 6 months | 5,660 | 6,333 | 14.02 | 13.74 | 828 | 843 | 17.27 | 11.32 | 0.0128 | |
| 2 | Lower limb arteropathy 3rd and 4th degree amputations at 6 months | 4.491 | 5,086 | 4.71 | 3.97 | 592 | 712 | 6.24 | 6.69 | | 0.0016 |
| 6 | Pulmonary embolism readmissions at 30 days after hospitalization | 13.445 | 9,987 | 8.99 | 8.18 | 3,372 | 2,429 | 7.56 | 6.02 | 0.0086 | 0.0012 |
| 10 | STEMI: % patients treated with PTCA within 90 minutes | 27,821 | 28,587 | 53.31 | 53.91 | 4,800 | 4,958 | 50.06 | 51.12 | 0.0000 | 0.0002 |
| 11 | Unruptured abdominal aortic aneurysm repair: mortality at 30 days | 85.794 | 86.219 | 1.71 | 1.72 | 2,308 | 2,045 | 1.03 | 1.35 | 0.0168 | |
| 12 | Congestive heart failure: mortality at 30 days | 85,794 | 86,219 | 11.36 | 11.25 | 14,346 | 15,299 | 11.45 | 10.62 | | 0.0340 |
| 14 | Valvuloplasty heart valve replacement: mortality at 30 days | 41,128 | 40,014 | 2.38 | 2.52 | 10,773 | 9,873 | 1.68 | 1.83 | 0.0000 | 0.0002 |
| 15 | Ischemic stroke: readmissions at 30 days | 40,892 | 41,416 | 7.20 | 6.99 | 6,736 | 7,270 | 6.04 | 5.78 | 0.0006 | 0.0004 |
| 16 | Ischemic stroke: mortality at 30 days | 44.482 | 44,990 | 10.96 | 10.52 | 7,414 | 7,884 | 10.47 | 9.19 | | 0.0008 |
| 17 | Laparoscopic cholecystectomy: postoperative hospital stay < 3 days | 37,139 | 48,153 | 79.02 | 81.31 | 6,311 | 8,911 | 76.45 | 80.18 | 0.0000 | 0.0001 |
| 21 | Knee arthroscopy reoperation within 6 months | 67,011 | 55,023 | 0.97 | 1.04 | 9,646 | 8,096 | 0.58 | 0.70 | 0.0002 | 0.0074 |
| 22 | Hip replacement: revision within 2 years after surgery | 61,114 | 74,352 | 3.89 | 3.55 | 11,775 | 15,348 | 3.98 | 3.10 | | 0.0114 |
| 25 | Femoral neck fracture: mortality at 30 days | 65,657 | 66,766 | 6.41 | 6.33 | 9,843 | 9,934 | 6.95 | 6.27 | 0.0383 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | Surgical intervention for TM brain: mortality at 30 days | 29,135 | 29,334 | 2.66 | 2.92 | 7 | 7 | 2.13 | 2.64 | 0.01 | |
| 30 | Surgery for TM colon: mortality at 30 days | 37,074 | 35,131 | 4.20 | 4.48 | 6,323 | 5,721 | 3.82 | 368.00 | | 0.0108 |
| 32 | Surgery for TM pancreas: mortality at 30 days | 4,460 | 4,494 | 4.12 | 3.83 | 1,055 | 944 | 9.59 | 1.91 | | 0.0078 |
| 37 | Surgery for rectal TM: mortality at 30 days | 8,022 | 11,288 | 1.48 | 1.52 | 1,656 | 1,534 | 3.35 | 3.15 | 0.005 | 0.0038 |
| 38 | surgery for TM stomach: 30-day mortality | 7,908 | 7,363 | 4.95 | 5.04 | 1,656 | 1,534 | 3.35 | 3.15 | 0.005 | 0.0002 |
| 39 | Resection surgery at 120 days after conservative TM breast surgery | 31,810 | 34,274 | 6.11 | 5.93 | 6,997 | 7,455 | 5.22 | 4.70 | 0.0044 | 0.0002 |
| 40 | Resection surgery at 90 days after conservative TM breast surgery | N.D. | 34,911 | N.D. | 5.56 | N.D. | 7,641 | N.D. | 4.37 | | 0.0002 |
| 41 | Resection surgery at 90 days after conservative TM breast surgery with variables | N.D. | 34,911 | N.D. | 5.57 | N.D. | 7,641 | N.D. | 4.58 | | 0.0016 |
| 46 | COPD exacerbation: mortality at 30 days | 34,334 | 28,200 | 12.57 | 13.57 | 5,068 | 4,169 | 10.78 | 11.25 | 0.0014 | |
| 47 | COPD flare-up: 30-day hospital readmissions | 29,768 | 24,525 | 12.44 | 12.06 | 4,526 | 3,891 | 10.78 | 11.25 | 0.0014 | |

better average outcomes in accredited private hospitals compared to public hospitals. The differences observed in the last year between 30-day and 2-year readmissions for hip replacement continued. Average 30-day outcomes were better in private accredited hospitals, while 2-year outcomes were better in public hospitals. The largest difference between public and private accredited hospitals was observed in the proportion of primary caesarean sections, which was lower in public hospitals (ADJ average 16.46 vs. 19.48).

Table 3. Comparison of clinical outcomes ADJ 2021 - Lombardy Region private and public hospitals.

| Ref | Indicator | Public hospitals | | | Private accredited hospitals | | |
|---|---|---|---|---|---|---|---|
| | | N. cases | of which ADJ | average outcomes ADJ | N. cases | of which ADJ | average outcomes ADJ |
| 1 | Lower limb arteriopathy 3rd and 4th degree mortality at 6 months | 693 | 419 | 11.91 | 592 | 424 | 10.73 |
| 2 | Lower limb arteriopathy 3rd and 4th degree amputations at 6 months | 579 | 341 | 9.16 | 525 | 371 | 4.42 |
| 3 | Lower limb arteriopathy 3rd-4th degree revascularization. At 6 months | 579 | 341 | 14.80 | 525 | 371 | 14.92 |
| 4 | Coronary artery bypass: mortality at 30 days. | 1,778 | 1,778 | 3.13 | 1,405 | 1,387 | 1.72 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | Coronary artery bypass mortality at 30 days with clinical variables | 1,778 | 1,778 | 2.55 | 1,405 | 1,387 | 1.72 |
| 6 | Pulmonary embolism readmissions at 30 days after hospitalization | 3,234 | 2,136 | 5.97 | 917 | 293 | 6.45 |
| 7 | Pulmonary embolism: mortality at 30 days after hospitalization | 3,466 | 2,381 | 9.15 | 976 | 311 | 7.40 |
| 8 | Acute myocardial infarction: 30-day mortality. | 9,264 | 8,946 | 7.99 | 3,511 | 3,462 | 6.62 |
| 9 | Acute myocardial infarction: 30-day mortality with clinical variables | 9,264 | 8,946 | 7.73 | 3,511 | 3,462 | 6.78 |
| 10 | STEMI: %patients treated with PTCA within 90 minutes | 4,107 | 3,763 | 51.17 | 1,513 | 1,195 | 50.95 |
| 11 | Unruptured abdominal aortic aneurysm repair: mortality at 30 days | 1,390 | 1,057 | 1.63 | 1,316 | 988 | 1.04 |
| 12 | Congestive heart failure: mortality at 30 days | 11,444 | 11,117 | 11.01 | 4,454 | 4,182 | 9.58 |
| 13 | Congestive heart failure: readmissions at 30 days readmissions | 9,749 | 9,381 | 11.42 | 2,770 | 2,335 | 13.82 |
| 14 | Valvuloplasty heart valve replacement: mortality at 30 days | 3,166 | 3,159 | 2.26 | 6,714 | 6,714 | 1.62 |
| 15 | Ischemic stroke: readmissions at 30 days | 6,191 | 5,877 | 5.44 | 1,695 | 1,393 | 7.21 |
| 16 | Ischemic stroke: mortality at 30 days | 6,673 | 6,301 | 9.28 | 1,802 | 1,583 | 8.85 |
| 17 | Laparoscopic cholecystectomy: postoperative hospital stay < 3 days | 5,734 | 5,274 | 75.37 | 3,872 | 3,637 | 87.15 |
| 18 | Cholecystectomy ordinary regimen: complications at 30 days | 9,281 | 8,028 | 2.66 | 6,387 | 5,555 | 1.48 |
| 19 | Knee replacements: readmissions at 30 days | 1,488 | 957 | 1.02 | 9,709 | 9,657 | 1.15 |
| 20 | Knee replacement: revision within 2 years after surgery | 3,069 | 2,885 | 2.01 | 11,109 | 11,047 | 2.24 |
| 21 | Knee arthroscopy reoperation within 6 months | 2,191 | 1,003 | 1.03 | 9,161 | 8,202 | 0.65 |
| 22 | Hip replacement: revision within 2 years after surgery | 7,094 | 7,002 | 1.73 | 11,373 | 11,240 | 1.86 |
| 23 | Hip replacements: readmissions at 30 days | 5,338 | 4,843 | 3.49 | 10,560 | 10,505 | 2.92 |
| 24 | Shoulder prostheses: readmissions at 30 days | 976 | 408 | 2.51 | 1,213 | 920 | 1.99 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 25 | Femoral neck fracture: mortality at 30 days | 7,239 | 7,079 | 6.05 | 2,958 | 2,855 | 6.82 |
| 26 | Femoral neck fracture in over 65s: surgery within 48h of facility access | 8,180 | 7,872 | 47.81 | 3,085 | 3,148 | 61.15 |
| 27 | Femoral neck fracture in over 65s: surgery within 2 days | 8,005 | 7,867 | 61.00 | 3,193 | 3,080 | 80.57 |
| 28 | Tibia and fibula fracture: waiting time for surgery | NA | 632 | 4 | NA | 233 | 3 |
| 29 | Surgical intervention for TM brain: mortality at 30 days | 4,867 | 4,763 | 2.59 | 2,196 | 2,159 | 2.77 |
| 30 | Surgery for TM colon: mortality at 30 days | 4,546 | 3,889 | 3.86 | 2,355 | 1,832 | 2.99 |
| 31 | Surgery for TM liver: mortality at 30 days | 1,708 | 1,240 | 1.50 | 1,017 | 877 | 1.30 |
| 32 | Surgery for TM pancreas: mortality at 30 days | 713 | 293 | 3.07 | 781 | 651 | 1.38 |
| 33 | Surgery for TM lung: mortality rate at 30 days | 4,183 | 3,975 | 0.72 | 2,923 | 2,834 | 0.82 |
| 34 | Prostate TM surgery: readmissions at 30 days | 1,059 | 433 | 3.01 | 1,902 | 1,418 | 3.00 |
| 35 | Prostate TM surgery: readmissions at 30 days with new variables | 1,059 | 433 | 3.00 | 1,902 | 1,418 | 2.91 |
| 36 | Surgery for kidney TM: mortality at 30 days | 3,237 | 2,723 | 0.59 | 2,550 | 2,098 | 0.36 |
| 37 | Surgery for rectal TM: mortality at 30 days | 1,419 | 986 | 1.19 | 1,162 | 915 | 0.00 |
| 38 | surgery for TM stomach: 30-day mortality | 1,924 | 901 | 4.10 | 1,157 | 633 | 1.79 |
| 39 | Resection surgery at 120 days after conservative TM breast surgery | 3,991 | 3,788 | 6.05 | 3,675 | 3,667 | 3.31 |
| 40 | Resection surgery at 90 days after conservative TM breast surgery | 4,088 | 3,904 | 5.52 | 3,744 | 3,737 | 3.16 |
| 41 | Resection surgery at 90 days after conservative TM breast surgery with variables | 4,088 | 3,904 | 5.78 | 3,744 | 3,737 | 3.33 |
| 42 | Proportion of deliveries by primary cesarean section | 43,592 | 43,350 | 16.46 | 10,323 | 10,322 | 19.48 |
| 43 | Caesarean sections: % subsequent hospitalizations during puerperium | 25,394 | 25,179 | 1.14 | 6,415 | 6,415 | 0.85 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 44 | Vaginal deliveries: % subsequent hospitalizations during puerperium | 73,414 | 73,120 | 0.70 | 16,696 | 16,694 | 0.52 |
| 45 | Vaginal parts: proportion of episiotomies | 37,051 | 37,049 | 12.07 | 6,489 | 8,489 | 12.91 |
| 46 | COPD exacerbation: mortality at 30 days | 4,168 | 2,920 | 11.20 | 1,974 | 1,249 | 6.05 |
| 47 | COPD flare-up: 30-day hospital readmissions | 3,823 | 2,682 | 12.43 | 1,884 | 1,209 | 8.65 |
| 48 | Chronic renal failure: mortality at 30 days after hospitalization | 7,438 | 6,520 | 11.15 | 2,777 | 2,103 | 9.84 |

## Discussion

This study provided an overview of the status of the Italian hospital network based on data from the PNE. The results showed significant reductions in hospital admissions and outcome measures in all clinical areas during the COVID-19 pandemic. Despite the difficulties, the Lombardy health system showed resilience by increasing its performance, with slight reductions in volumes, during 2021. Due to the significant contribution of private healthcare providers, Lombardy consistently maintained its dominant position in the national clinical outcome rankings, outperforming the national average in 2019-2021.

The spread of SARS-CoV-2 has had a global impact on the world economy and both on accessibility to and quality of health services (23). This has requested a reorganization of the service network on a scale unprecedented in modern history. (24-25). As outlined in this paper for Italy, other countries around the World have also experienced the negative effects of the pandemic on hospital quality and volume (23). In addition, hospitals have come under increasing pressure over the years and have often been seen as a major potential source of cuts in public health systems (26). Data from the World Health Organization (WHO) showed that the number of hospitals has been drastically reduced across Europe since the early 1990s, particularly in Belgium and Italy. Underfunding of health services could also have affected quality assessment (27). This substantial organizational commitment, in addition to a hospital network that had been minimized by national regulations in previous years, could only lead to a compression of the volume of services provided for other pathologies. Moreover, it exposed the system to the risk of an overall decline in quality. Our report contributed to a partial assessment of these effects, particularly regarding hospital admissions in Italy.

The reduction in the volume of total activity was confirmed for all major pathologies, both nationally and in Lombardy. In that region, the decrease in the volume of activity was also determined by an extreme reduction in interregional health mobility. Lombard's active healthcare mobility constitutes approximately 20% of the national total; therefore, the reduction in the volume of Lombard activity must also be linked to lockdown policies and the ban on interregional crossings. Moreover, the trend of decrease was in line with the general characteristics of the epidemic curve (28), which was more pronounced in 2020 (-16% admissions in Italy) compared to 2021 (-11.8% admissions in Italy), and the geographical distribution, which showed more significant decreases in Lombardy (-21.3% in 2020 and -14% in 2021). It is important to consider, however, that the substantial number of cases within the groups should have no bearing on the content and conclusions of this study.

Our examination of data covering three years (2019-2021) has allowed a more thorough assessment of the trends in the events, covering both quantitative and qualitative aspects. Concerning the volume of admissions and the quality of clinical outcomes, the three years examined for the preparation of this report had a particular feature. This period was characterized by cases treated in 2020, which were influenced by factors related to the acute phase of the COVID-19 pandemic. Based on the data reported in the 2022 edition of the PNE, it was observed that the volume of admissions in 2021 experienced a relevant recovery

compared to 2020 and showed a tendency to return to the values of 2019, although not fully complete, due to the lingering effects of the pandemic, albeit in a less acute phase. The average of clinical outcomes above the national average in Lombardy was 40 indicators out of 48 (83%), compared to 27 out of 43 (63%) in 2020. The resumption of a growth trend was confirmed by comparison with data from 2019, before the pandemic, when 79% (33 out of 42) of the indicators in Lombardy were above the national average.

The decrease in the number of hospital admissions in Lombardy in 2020 compared to 2019 was 20.7% for the public sector and 22.5% for the private sector. In 2021, this decline slowed down to 16.7% and 9.3% respectively. The remarkable recovery of the private sector, which grew by 13.2% (if compared to the previous year), seems to contribute to the positive response of the whole regional system.

In any case, even in terms of the quality of clinical outcomes, the Italian National Health Service has shown overall resilience, albeit with some differences between regions and, within regions, between public and private accredited hospitals. The very positive contribution made by the private sector in each of the three years under review has been confirmed. The data for a particularly critical year, such as 2020, highlighted the ability of private accredited hospitals to operate in a context of integration and subsidiarity, even in situations of emergency. In a hospital system with a high degree of public-private integration, such as that of Lombardy, the overall trend in the reduction of admissions was very similar in both its components, equally involved in the reorganization of the hospital network (29). There was a slightly greater decline in private admissions in 2020 (-20.7% public, -22.5% private) and a faster recovery of the private sector in 2021 (-16.7% public, -9.3% private). The 102 private accredited hospitals in Lombardy, representing 39% of the total of 214 hospitals, recorded 118,074 admissions. This observation implies that private health services play a significant role in the provision of healthcare in the Region. This raises further questions about the relative performance of private versus public hospitals (30).

The analysis revealed several critical areas in healthcare. One of the main problems was the lack of homogeneity between hospitals, in terms of different volumes of activities and health outcomes. In fact, according to the Italian Ministerial Decree 70/2015, hospitals should reach or exceed the set volume threshold. In addition, other problems were delays in treatment, which affect both emergency networks and the organization within hospitals, inappropriate clinical and organizational practices, and inappropriate hospitalizations, which could be avoide by correct and prompt local management of patients (31).

## Limits

A limitation of the study was the evaluation of a specific set of indicators. Specifically, the Scientific Committee selected 48 process/outcome indicators out of a total of 73 (66%) defined by AGENAS to assess the quality of hospital facilities. In addition, 45 out of 83 indicators (54%) were selected for the volume of cases treated by hospitals. Another limitation of the study is its predominantly descriptive nature, with no analysis of statistically significant differences in the many sections.

## Conclusions

At the end, the Lombardy mixed (public + private) hospital network, although severely affected by the pandemic, responded efficaciously to the dual challenge of drastically reorganizing service provision and maintaining the highest levels of quality in routine activities. In Lombardy, activities experienced an inevitable decline in volume, especially during the first wave of the pandemic, but showed a remarkable capacity for recovery during the subsequent phases of the pandemic, especially if compared to the national average. The public/private mix that characterizes the structure of the Lombardy Health Service can be considered an option to create a more balanced and flexible model at a national level, capable of withstanding significant stress while maintaining good performance.


### Riassunto

***Qualità dell'assistenza ospedaliera ed esiti clinici: un confronto tra la regione Lombardia e i dati nazionali***

**Background**. Il potenziamento della qualità e dell'efficacia dell'assistenza sanitaria costituisce una priorità fondamentale nella politica sanitaria. La pandemia da COVID-19 ha esercitato una notevole pressione sulle reti ospedaliere, rendendo necessarie azioni di riorganizzazione e ristrutturazione senza precedenti. Questo studio ha analizzato i dati del Programma Nazionale Esiti per confrontare alcuni volumi ed esiti degli ospedali della Regione Lombardia, pubblici e provati accreditati, con i dati nazionali.

**Disegno dello studio.** Studio osservazionale.

**Metodi**. È stata condotta un'analisi degli esiti ospedalieri per gli anni 2019-2021, utilizzando 45 indicatori di volume e 48 indicatori di processo/esito clinico confrontando gli ospedali lombardi con il resto d'Italia e quelli pubblici con quelli privati accreditati.

**Risultati.** Nel 2020, l'Italia e la Lombardia hanno registrato una notevole riduzione dei ricoveri ospedalieri complessivi, con la Lombardia che ha mostrato una diminuzione più pronunciata (21,3% rispetto al 16,0% dell'Italia). Nel 2021, entrambe hanno registrato una parziale ripresa, particolarmente marcata in regione Lombardia (7,3 in più rispetto al dato nazionale). Concentrandosi specificamente sul settore privato, la Lombardia ha evidenziato una ripresa del 9,3%. Analizzando gli esiti clinici, la Lombardia supera la media nazionale per il 63% degli indicatori nel 2020 e 83,3% nel 2021.

**Conclusioni.** Lo studio mostra il perdurante calo dei volumi rispetto al 2019 (pre-COVID), le ottime performance degli ospedali lombardi e un contributo significativo sia dei volumi che della qualità degli esiti degli ospedali privati accreditati.

## References

1. Decree Law 28 July 2012, n. 135. Disposizioni urgenti per la revisione della spesa pubblica con invarianza dei servizi ai cittadini. Available from: www.gazzettaufficiale.it [Last accessed: 2023 Dec 12].
2. Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy. Early experience and forecast during an emergency response. JAMA. 2020 Apr 28;**323**(16):1545–1546. doi: 10.1001/jama.2020.4031. PMID: 32167538.
3. Kaye AD, Okeagu CN, Pham AD, Silva RA, Hurley JJ, Arron BL, et al. Economic impact of COVID-19 pandemic on healthcare facilities and systems: International perspectives. Best Pract Res Clin Anaesthesiol. 2021 Oct;**35**(3):293-306. doi: 10.1016/j.bpa.2020.11.009. Epub 2020 Nov 17. PMID: 34511220; PMCID: PMC7670225.
4. De Cola MC, Ielo A, Corallo F, Pollina Addario S, Scondotto S, et al. Development of a Set of Indicators for Measuring and Improving Quality of Rehabilitation Care after Ischemic Stroke. Healthcare (Basel). 2023 Jul 19;**11**(14):2065. doi: 10.3390/healthcare11142065. PMID: 37510506; PMCID: PMC10378746.
5. Colais P, Pinnarelli L, Mataloni F, Giordani B, Duranti G, D'errigo P, et al. The National Outcomes Evaluation Programme in Italy: The Impact of Publication of Health Indicators. Int J Environ Res Public Health. 2022 Sep 16;**19**(18):11685. doi: 10.3390/ijerph191811685. PMID: 36141957; PMCID: PMC9517347.
6. AGENAS - Agenzia Nazionale per i servizi Sanitari Regionali. PNE - Piano Nazionale Esiti (2022). Available from: http://pne.agenas.it. [Last accessed: 2023 Dec 12].
7. Italian Ministry of Health. La Scheda di Dimissione. Ospedaliera (SDO). Available from: https://www.salute.gov.it/portale/temi/p2_6.jsp?area=ricoveriOspedalieri&id=1232&menu=vuot. [Last accessed: 2023 Dec 14].
8. Italian Ministry of Health [Internet] Assistenza Emergenza—Urgenza. Available from: https://www.salute.gov.it/portale/temi/p2_6.jsp?lingua=italiano&id=2990&area=sistemaInformativo&menu=emergenza [Last accessed: 2023 Dec 14].
9. Ciani O, Federici CB, Furnari A, Pongiglione B, Tarricone R. Esiti di salute e performance del Servizio Sanitario Nazionale. In: Egea, editor. Rapporto OASI 2020, 2020:291-343. Available from: https://hdl.handle.net/11565/4032768. [Last accessed: 2023 Dec 15].
10. Cartabellotta A. Standard ospedalieri: uno strumento per garantire uniformità ed equità dell'assistenza. Evidence. 2015;7(12): e1000125 doi: 10.4470/E1000125.
11. Di Stanislao F. La valutazione della performance nel sistema sanitario, PRISMA Economia - Società - Lavoro, Franco Angeli Editore; 2012, vol. 3: 39-57.
12. Amato L, Colais P, Davoli M, Ferroni E, Fusco D, Minozzi S, et al. Volumi di attività ed esiti delle cure: prove scientifiche dalla letteratura e dalle valutazioni empiriche in Italia. Epidemiol Prev. 2013 Mar-Jun;**37**(2-3 Suppl 2):1-100. Italian. PMID: 23851286.
13. Basiglini A, Moirano F, Perucci CA. Valutazioni comparative di esito in Italia: ipotesi di utilizzazione e di impatto. Mecosan 2011; 20:9-35.
14. CERGAS – Bocconi. Rapporto OASI 2022. Osservatorio sulle Aziende e sul Sistema sanitario Italiano. Available from: https://cergas.unibocconi.eu/sites/default/files/media/attach/7.%20Esiti%20di%20salute%20e%20performance%20del%20SSN_Ardito%2C%20Federici%2C%20Furnari%2C%20Ciani%2C%20Tarricone_0.pdf?VersionId=tree7W_cIGjn7SLyU6IHbiE53TWZs7J5 [Last accessed: 2023 Dec 15].
15. Odone A, Delmonte D, Scognamiglio T, Signorelli C. COVID-19 deaths in Lombardy, Italy: data in context. Lancet Public Health. 2020 Jun;**5**(6):e310. doi: 10.1016/S2468-2667(20)30099-2. Epub 2020 Apr 25. PMID: 32339478; PMCID: PMC7182509.
16. Signorelli C, Odone A, Gianfredi V, Bossi E, Bucci D, Oradini-Alacreu A, et al. COVID-19 mortality rate in nine high-income metropolitan regions. Acta Biomed. 2020 Jul 20;**91**(9-S):7-18. doi: 10.23750/abm.v91i9-S.10134. PMID: 32701911.
17. Stirparo G, Oradini-Alacreu A, Migliori M, Villa GF, Botteri M, Fagoni N, et al. Public health impact of the COVID-19 pandemic on the emergency healthcare system. J Public Health (Oxf). 2022 mar 7; **44**(1): e149-e152. doi: 10.1093/pubmed/fdab212. PMID: 34156071; PMCID: PMC8344573.
18. Mauer N, Chiecca G, Carioli G, Gianfredi V, Iacoviello L, Bertagnolio S, et al. The First 110,593 COVID-19 Patients Hospitalised in Lombardy: A Regionwide Analysis of Case Characteristics, Risk Factors and Clinical Outcomes. Int J Public Health. 2022 May 11;**67**:1604427. doi: 10.3389/ijph.2022.1604427. PMID: 35645700; PMCID: PMC9131487.
19. Signorelli C, Odone A. Age-specific COVID-19 case-fatality rate: no evidence of changes over time. Int J Public Health.

2020 Nov;**65**(8):1435-1436. doi: 10.1007/s00038-020-01486-0. Epub 2020 Sep 25. PMID: 32978645; PMCID: PMC7518649.

20. Signorelli C, Odone A, Oradini-Alacreu A, Pelissero G. Universal Health Coverage in Italy: lights and shades of the Italian National Health Service which celebrated its 40th anniversary. Health Policy. 2020 Jan; **124**(1):69-74. doi: 10.1016/j.healthpol.2019.11.002. Epub 2019 Nov 12. PMID: 31812325.
21. Signorelli C, Odone A, Gozzini A, Petrelli F, Tirani M, Zangrandi A, et al.The missed Constitutional Reform and its possible impact on the sustainability of the Italian National Health Service. Acta Biomed. 2017 Apr 28; **88**(1):91-4. doi: 10.23750/abm.v88i1.6408. PMID: 28467341; PMCID: PMC6166202.
22. WHO, the European Observatory on Health Systems and Policies. Engaging the private sector in delivering health care and goods. Governance lessons from the COVID-19 pandemic. Policy Brief 56. Available from: https://eurohealthobservatory.who.int/publications/i/engaging-the-private-sector-in-delivering-health-care-and-goods-governance-lessons-from-the-covid-19-pandemic. [Last accessed: 2023 Dec 14].
23. Kaye AD, Okeagu CN, Pham AD, Silva RA, Hurley JJ, Arron BL, et al. Economic impact of COVID-19 pandemic on healthcare facilities and systems: International perspectives. Best Pract Res Clin Anaesthesiol. 2021 Oct; **35**(3):293–306. 10.1016/j.bpa.2020.11.009. Epub 2020 Nov 17. PMID: 34511220; PMCID: PMC7670225.
24. Brambilla A, Sun TZ, Elshazly W, Ghazy A, Barach P, Lindahl G, et al. Flexibility during the COVID-19 Pandemic Response: Healthcare Facility Assessment Tools for Resilient Evaluation. Int J Environ Res Public Health. 2021 Oct 31;**18**(21):11478. doi: 10.3390/ijerph182111478. PMID: 34769993; PMCID: PMC8583089.
25. Pennisi F, Odelli S, Borlini S, Morani F, Signorelli C, Renzi C. Impact of the Covid pandemic on timely cancer diagnosis across European healthcare settings: a scoping review. Ann Ig. 2024 Jan 18. doi: 10.7416/ai.2024.2596. Epub ahead of print. PMID: 38240184.
26. Tuczyńska M, Staszewski R, Matthews-Kozanecka M, Żok A, Baum E. Quality of the Healthcare Services During COVID-19 Pandemic in Selected European Countries. Front Public Health. 2022 May 12;**10**:870314. doi: 10.3389/fpubh.2022.870314. PMID: 35646786; PMCID: PMC9133554.
27. Prante FJ, Bramucci A, Truger A. Decades of tight fiscal policy have left the health care system in Italy Ill-prepared to fight the COVID-19 outbreak. Inter Econ. 2020; **55**(3):147–52. 10.1007/s10272-020-0886-0. Epub 2020 Jun 7. PMID: 32536710; PMCID: PMC7276098.
28. Mannucci PM, Galbussera AA, D'Avanzo B, Tettamanti M, Remuzzi G, Fortino I, et al. Two years of SARS-CoV-2 pandemic and COVID-19 in Lombardy, Italy. Intern Emerg Med. 2023 Aug;**18**(5):1445-1451. doi: 10.1007/s11739-023-03315-7. Epub 2023 Jun 14. PMID: 37314640.
29. Bobini M, Longo F, Ricci A. Gli erogatori privati accreditati: inquadramento e ruolo nella risposta del SSN al Covid-19. In: CERGAS Bocconi, Ed. Rapporto Oasi 2020. Milano: Egea; 2020: 163-202.
30. Kruse FM, Stadhouders NW, Adang EM, Groenewoud S, Jeurissen PPT. Do private accredited hospitals outperform public hospitals regarding efficiency, accessibility, and quality of care in the European Union? A literature review. Int J Health Plann Manage. 2018 Apr; **33**(2):e434-e53. doi: 10.1002/hpm.2502. Epub 2018 Mar 2. PMID: 29498430; PMCID: PMC6033142.
31. Ministero della Salute e Ministero dell'Economia e delle Finanze. Decree Law 2 April 2015 n. 70. Regolamento recante definizione degli standard qualitativi, strutturali, tecnologici e quantitativi relativi all'assistenza ospedaliera. G.U. 4 giugno 2015, n. 127. Available from: https://www.camera.it/temiap/2016/09/23/OCD177-2353.pdf [Last Accessed: 2023 Dec 5].

# Appendix

Table 1A – Variation in the volume of hospital admissions 2019-2021. Full version.

| | | Italy | | | | | Lombardy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ref | Indicator | 2019 | 2020 | 2021 | Deviation | | 2019 | 2020 | 2021 | Deviation | |
| | | | | | 20/19 | 21/19 | | | | 20/19 | 21/19 |
| 1 | Lower limb arteriopathy II°-IV° grade | 39,627 | 30,536 | 33,992 | -22.9% | -14.2% | 6,402 | 4,502 | 4,897 | -29.7% | -23.5% |
| 2 | Coronary artery bypass surgery | 14,185 | 10,681 | 11,953 | -24.7% | -15.7% | 2,308 | 1,641 | 1,737 | -28.9% | -24.7% |
| 3 | Pulmonary embolism | 35,287 | 38,393 | 45,949 | 8.8% | 30.2% | 6,746 | 8,493 | 9,293 | 25.9% | 37.8% |
| 4 | Acute myocardial infarction | 123,336 | 105,742 | 106,673 | -14.3% | -13.5% | 20,841 | 17,372 | 17,707 | -16.6% | -15.0% |
| 5 | Unrupted abdominal aortic aneurysm repair | 9,060 | 7,096 | 8,075 | -21.7% | -10.9% | 1,996 | 1,287% | 1,595 | -35.5% | -20.1% |
| 6 | Carotid revascularisation | 22,134 | 17,611 | 20,010 | -20.4% | -9.6% | 4,147 | 2,892 | 3,566 | -30.3% | -14.0% |
| 7 | Congestive heart failure | 156,493 | 116,807 | 120,111 | -25.4% | -23.2% | 26,614 | 19,723 | 21,075 | -25.9% | -20.8% |
| 8 | Vein stripping | 20,096 | 10,141 | 12,132 | -49.5% | -39.6% | 478 | 294 | 456 | -38.5% | -4.6% |
| 9 | Deep vein thrombosis | 7,264 | 5,640 | 5,626 | -22.4% | -22.5% | 1,129 | 984 | 925 | -12.8% | -18.1% |
| 10 | Valvuloplasty or cardiac valve replacement | 35,609 | 29,238 | 33,919 | -17.9% | -4.7% | 8,685 | 6,307 | 7,745 | -27.4% | -10.8% |
| | Cardiovascular area | 463,091 | 371,885 | 398,440 | -19.7% | -14.0% | 79,346 | 63,495 | 68.996 | -20.0% | -13.0% |
| 11 | Ruptured and unruptured brain aneurysm | 3,392 | 3,022 | 3,234 | -10.9% | -4.7% | 774 | 647 | 620 | -16.4% | -19.9% |
| 12 | Sub arachnoid haemorrhage | 8,063 | 7,471 | 7,732 | -7.3% | -4.1% | 1141 | 1122 | 1083 | -1.7% | -5.1% |
| 13 | Ischaemic stroke | 83,837 | 73,494 | 73,276 | -12.3% | -12.6% | 12,641 | 11,067 | 11,495 | -12.5% | -9.1% |
| | Cerebrovascular area | 95,292 | 83,987 | 84,242 | -11.9% | -11.6% | 14.556 | 12.836 | 13.198 | -11.8% | -9.3% |
| 14 | Laparoscopic cholecystectomy | 98,779 | 69,890 | 83,268 | -29.2% | -15.7% | 16,501 | 10,252 | 13,078 | -39.7% | -20.7% |
| 15 | Routine cholecystectomy | 12,183 | 9,890 | 9,647 | -18.8% | -20.8% | 2,358 | 1,737 | 1,741 | -26.3% | -26.2% |
| | Digestive area | 110,962 | 79,780 | 92,915 | -28.1% | -16.3% | 18,859 | 11,989 | 14,819 | -36.4% | -21.4% |
| 16 | Knee arthroscopy | 54,920 | 39,100 | 43,204 | -28.8% | -21.3% | 9,046 | 5,534 | 6,401 | -38.8% | -29.2% |
| 17 | Femoral neck fracture | 102,839 | 95,456 | 97,329 | -7.2% | -5.4% | 15,336 | 14,226 | 14,089 | -7.2% | -8.1% |
| 18 | Tibia and fibula fracture | 15,818 | 14,276 | 15,408 | -9.7% | -2.6% | 2,536 | 2,219 | 2,467 | -12,5% | -2.7% |
| 19 | Hip replacement | 115,989 | 96,822 | 115,097 | -16.5% | -0.8% | 24,454 | 17,508 | 22,912 | -28,4% | -6.3% |
| 20 | Knee prosthesis | 87,922 | 66,691 | 80,465 | -24.1% | -8.5% | 19,183 | 11,462 | 16,332 | -40,2% | -14.9% |
| 21 | Shoulder prosthesis | 11,219 | 9,405 | 11,620 | -16.2% | 3.6% | 1,763 | 1,225 | 1,596 | -30,5% | -9.5% |
| | Musculo-skeletal area | 291,585 | 247,674 | 363,123 | -15.1% | 25.2% | 72,318 | 52,174 | 63,797 | -27.9% | -11.8% |
| 22 | Malignant brain tumour surgery: craniotomies | 13,237 | 12,447 | 13,136 | -6.0% | -0.8% | 3,300 | 2,842 | 3,085 | -13.99% | -6.5% |
| 23 | Colon cancer surgery: | 26,233 | 23,078 | 24,796 | -12.0% | -5.5% | 4,607 | 3,680 | 4,064 | -20.1% | -11.8% |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Liver cancer surgery | 6,610 | 6,195 | 5,961 | -6.35 | -9.8% | 1,557 | 1,275 | 1,284 | -18.1% | -17.5% |
| 25 | Breast cancer surgery | 62,343 | 56,057 | 62,764 | -10.1% | 0.7% | 14,667 | 11,811 | 13,829 | -19.5% | -5.7% |
| 26 | Pancreatic cancer surgery | 2,710 | 2,778 | 2,766 | 2.5% | 2,1% | 649 | 564 | 579 | -13.1% | -10.8% |
| 27 | Lung cancer surgery | 12,116 | 11,078 | 11,532 | -8.6% | -4.8% | 3,044 | 2,466 | 2,674 | -19.0% | -12.2% |
| 28 | Prostate cancer surgery | 20,688 | 17,115 | 18,645 | -17.3% | -9.9% | 4,601 | 3,103 | 3,689 | -32.6% | -19.8% |
| 29 | Kidney cancer surgery | 11,907 | 10,665 | 11,676 | -10.4% | -1.9% | 2,362 | 1,872 | 2,058 | -20.7% | -12.9% |
| 30 | Rectal cancer surgery | 6,051 | 5,627 | 5,615 | -7.0% | -7.2% | 1,091 | 914 | 913 | -16.2% | -16.3% |
| 31 | Stomach cancer surgery | 5,824 | 5,088 | 5,075 | -12.6% | -12.9% | 1,243 | 964 | 1,068 | -22.4% | -14.1% |
| 32 | Oral cancer surgery | 2,701 | 2,502 | 2,521 | -7.4% | -6.7% | 560 | 520 | 549 | -7.1% | -2.0% |
| 33 | Cholecyst tumour surgery | 771 | 713 | 731 | -7.5% | -5.2% | 96 | 125 | 137 | 30.2% | 42.7% |
| 34 | Oesophageal cancer surgery | 856 | 827 | 869 | -3.4% | 1.5% | 300 | 266 | 304 | -11.3% | 1.3% |
| 35 | Laryngeal cancer surgery | 5,030 | 4,603 | 4,846 | -8.5% | -3.7% | 892 | 674 | 785 | -24.4% | -12.0% |
| 36 | Ovarian cancer surgery | 4,058 | 3,953 | 3,909 | -2.6% | -3.7% | 970 | 828 | 853 | -14.6% | -12.1% |
| 37 | Thyroid tumour surgery | 10,237 | 9,014 | 10,346 | -11.9% | 1.1% | 1,668 | 1,286 | 1,655 | -22.9% | -0.8% |
| 38 | Uterine cancer surgery | 12,349 | 11,643 | 12,103 | -5.7% | -2.0% | 2,447 | 2,127 | 2,254 | -13.1% | -7.9% |
| 39 | Bladder cancer surgery | 5,211 | 5,241 | 5,101 | 0.6% | -2.1% | 987 | 835 | 804 | -15.4% | -18.5% |
| Oncology area | | 208,932 | 188,624 | 202,392 | -9.7% | -3.1% | 45,041 | 36,152 | 40,584 | -19.7% | -9-9% |
| 40 | Caesarean sections | 137,189 | 131,390 | 129,369 | -4.2% | -5.7% | 19,073 | 17,922 | 17,903 | -6.0% | -6.1% |
| 41 | Natural childbirth | 279,955 | 272,745 | 269,137 | -2.6% | -3.9% | 53,808 | 51,412 | 50,767 | -4.5% | -5.7% |
| Perinatal area | | 417,144 | 404,135 | 398,506 | -3.1% | -4.5% | 72,881 | 69,334 | 68,670 | -4.9% | -5.8% |
| 42 | COPD exacerbation | 102,475 | 60,640 | 56,317 | -40.8% | -45.0% | 17,013 | 9,685 | 9.324 | -43.1% | -45.2% |
| Respiratory area | | 102,475 | 60,640 | 56,317 | -40.8% | -45.0% | 17,013 | 9,685 | 9.324 | -43.1% | -45.2% |
| 43 | Chronic renal failure | 134,902 | 104,645 | 101,473 | -22.4% | -24.8% | 14.613 | 10,752 | 10,215 | -26.4% | -30.1% |
| 44 | Hysterectomy | 56,702 | 44,114 | 51,067 | -22.2% | -9.9% | 11.671 | 7,468 | 9,112 | -36.0% | -21.9% |
| 45 | Prostatectomy | 38,574 | 27,350 | 32,975 | -29.1% | -14.5% | 6.867 | 3,894 | 5,153 | -43.3% | -25.0% |
| Urogenital area | | 230,178 | 176,109 | 185,515 | -23.5% | -19.4% | 33.151 | 22,114 | 24,480 | -33.3% | -26.2% |
| Total hospitalisations | | 1,919,659 | 1,612,834 | 1,781,450 | -16.0% | -11.8% | 353,165 | 277,779 | 303,868 | -21.3% | -14.0% |

Table 2A – Number of treated cases and clinical outcomes ADJ in 2019-2021. Comparison Italy-Lombardy. Full Version.

| Ref | Indicator | Italy | | | | Lombardy | | | | p Value 2020 | p Value 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n. cases | | ADJ | | n. cases | | outcome ADJ | | | |
| | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | | |
| 1 | Lower limb arteriopathy 3rd and 4th degree mortality at 6 months | 5,660 | 6,333 | 14.02 | 13.74 | 828 | 843 | 17.27 | 11.32 | 0.0128 | |
| 2 | Lower limb arteripathy 3rd and 4th degree amputations at 6 months | 4.491 | 5,086 | 4.71 | 3.97 | 592 | 712 | 6.24 | 6.69 | | 0.0016 |
| 3 | Lower limb arteriopathy 3rd-4th degree revascularization. At 6 months | 4.491 | 5,086 | 16.65 | 17.61 | 592 | 712 | 17.58 | 14.87 | | |
| 4 | Coronary artery bypass: mortality at 30 days. | 23.537 | 20,989 | 1.85 | 2.17 | 3,760 | 3,165 | 1.97 | 2.51 | | |
| 5 | Coronary artery bypass mortality at 30 days with clinical variables | N.D. | 21,199 | N.D. | 2.37 | N.D. | 3,165 | N.D. | 2.18 | | |
| 6 | Pulmonary embolism readmissions at 30 days after hospitalization | 13.445 | 9,987 | 8.99 | 8.18 | 3,372 | 2,429 | 7.56 | 6.02 | 0.0086 | 0.0012 |
| 7 | Pulmonary embolism: mortality at 30 days after hospitalization | 14.730 | 11,288 | 10.59 | 9.16 | 3,597 | 2,692 | 9.56 | 8.95 | | |
| 8 | Acute myocardial infarction: 30-day mortality. | 72.549 | 67,186 | 8.13 | 7.64 | 11,911 | 12,408 | 9.19 | 7.61 | 0.0000 | |
| 9 | Acute myocardial infarction: 30-day mortality with clinical variables | N.D. | 73,188 | N.D. | 7.61 | N.D. | 12,408 | N.D. | 7.47 | | |
| 10 | STEMI: %patients treated with PTCA within 90 minutes | 27,821 | 28,587 | 53.31 | 53.91 | 4,800 | 4,958 | 50.06 | 51.12 | 0.0000 | 0.0002 |
| 11 | Unruptured abdominal aortic aneurysm repair: mortality at 30 days | 85.794 | 86.219 | 1.71 | 1.72 | 2,308 | 2,045 | 1.03 | 1.35 | 0.0168 | |
| 12 | Congestive heart failure: mortality at 30 days | 85,794 | 86,219 | 11.36 | 11.25 | 14,346 | 15,299 | 11.45 | 10.62 | | 0.0340 |
| 13 | Congestive heart failure: readmissions at 30 days readmissions | 62,054 | 64,575 | 13.44 | 13.53 | 10,355 | 11,716 | 13.25 | 11.90 | | 0.0000 |
| 14 | Valvuloplasty heart valve replacement: mortality at 30 days | 41,128 | 40,014 | 2.38 | 2.52 | 10,773 | 9,873 | 1.68 | 1.83 | 0.0000 | 0.0002 |
| 15 | Ischemic stroke: readmissions at 30 days | 40,892 | 41,416 | 7.20 | 6.99 | 6,736 | 7,270 | 6.04 | 5.78 | 0.0006 | 0.0004 |
| 16 | Ischemic stroke: mortality at 30 days | 44.482 | 44,990 | 10.96 | 10.52 | 7,414 | 7,884 | 10.47 | 9.19 | | 0.0008 |
| 17 | Laparoscopic cholecystectomy: posto-perative hospital stay < 3 days | 37,139 | 48,153 | 79.02 | 81.31 | 6,311 | 8,911 | 76.45 | 80.18 | 0.0000 | 0.0001 |
| 18 | Cholecystectomy ordinary regimen: complications at 30 days | 9,350 | 76,914 | 2.21 | 2.13 | 17,415 | 13,583 | 2.17 | 2.16 | | |
| 19 | Knee replacements: readmissions at 30 days | 43,682 | 52,813 | 1.67 | 1.41 | 7,576 | 10,614 | 1.98 | 1.30 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Knee replacement: revision within 2 years after surgery | 58,513 | 62,272 | 2.59 | 2.34 | 12,525 | 13,932 | 2.63 | 2.20 | | |
| 21 | Knee arthroscopy reoperation within 6 months | 67,011 | 55,023 | 0.97 | 1.04 | 9,646 | 8,096 | 0.58 | 0.70 | 0.0002 | 0.0074 |
| 22 | Hip replacement: revision within 2 years after surgery | 61,114 | 74,352 | 3.89 | 3.55 | 11,775 | 15,348 | 3.98 | 3.10 | | 0.0114 |
| 23 | Hip replacements: readmissions at 30 days | 770,727 | 81,416 | 1.85 | 1.81 | 17,462 | 18,242 | 1.78 | 1.81 | | |
| 24 | Shoulder prostheses: readmissions at 30 days | 12,352 | 12,238 | 1.60 | 1.66 | 1,635 | 1,328 | 1.91 | 2.16 | | |
| 25 | Femoral neck fracture: mortality at 30 days | 65,657 | 66,766 | 6.41 | 6.33 | 9,843 | 9,934 | 6.95 | 6.27 | 0.0383 | |
| 26 | Femoral neck fracture surgery within 48h of facility access | N.D. | 74,010 | N.D. | 48.37 | N.D. | 11,020 | N.D. | 51.62 | | 0.0000 |
| 27 | Femoral neck fracture in over 65s: surgery within 2 days | 71,326 | 73,505 | 64.59 | 64.24 | 10,855 | 10,947 | 67.77 | 66.50 | 0.0000 | 0.0000 |
| 28 | Tibia and fibula fracture: waiting time for surgery | 10,411 | 10,940 | 4.00 | 3.50 | 752 | 875 | 3.00 | 3.00 | | |
| 29 | Surgical intervention for TM brain: mortality at 30 days | 29,135 | 29,334 | 2.66 | 2.92 | 7 | 7 | 2.13 | 2.64 | 0.01 | |
| 30 | Surgery for TM colon: mortality at 30 days | 37,074 | 35,131 | 4.20 | 4.48 | 6,323 | 5,721 | 3.82 | 368.00 | | 0.0108 |
| 31 | Surgery for TM liver: mortality at 30 days | 8,648 | 8,676 | 1.94 | 2.05 | 2,137 | 2,117 | 1.80 | 1.41 | | |
| 32 | Surgery for TM pancreas: mortality at 30 days | 4,460 | 4,494 | 4.12 | 3.83 | 1,055 | 944 | 9.59 | 1.91 | | 0.0078 |
| 33 | Surgery for TM lung: mortality rate at 30 days | 25,470 | 25,198 | 0.97 | 1.03 | 6,202 | 5,909 | 0.95 | 0.82 | | |
| 34 | Prostate TM surgery: readmissions at 30 days | 9,135 | 10,109 | 3.39 | 3.76 | 1,568 | 1,851 | 3.27 | 3.00 | | |
| 35 | Prostate TM surgery: readmissions at 30 days with new variables | N.D. | 10,109 | N.D. | 3.66 | N.D. | 1,851 | N.D. | 2.93 | | |
| 36 | Surgery for kidney TM: mortality at 30 days | 25,228 | 25,716 | 0.76 | 0.75 | 4,983 | 4,821 | 0.66 | 0.48 | 0.0000 | |
| 37 | Surgery for rectal TM: mortality at 30 days | 8,022 | 11,288 | 1.48 | 1.52 | 1,656 | 1,534 | 3.35 | 3.15 | 0.005 | 0.0038 |
| 38 | Surgery for TM stomach: 30-day mortality | 7,908 | 7,363 | 4.95 | 5.04 | 1,656 | 1,534 | 3.35 | 3.15 | 0.005 | 0.0002 |
| 39 | Resection surgery at 120 days after conservative TM breast surgery | 31,810 | 34,274 | 6.11 | 5.93 | 6,997 | 7,455 | 5.22 | 4.70 | 0.0044 | 0.0002 |
| 40 | Resection surgery at 90 days after conservative TM breast surgery | N.D. | 34,911 | N.D. | 5.56 | N.D. | 7,641 | N.D. | 4.37 | | 0.0002 |
| 41 | Resection surgery at 90 days after conservative TM breast surgery with variables | N.D. | 34,911 | N.D. | 5.57 | N.D. | 7,641 | N.D. | 4.58 | | 0.0016 |
| 42 | Proportion of deliveries by primary cesarean section | 306,822 | 298,463 | 22.65 | 22.34 | 54,655 | 53,672 | 17.24 | 17.04 | 0.0000 | 0.0000 |
| 43 | Caesarean sections: % subsequent hospitalizations during pueperio | 241,984 | 231,717 | 0.92 | 0.78 | 33,884 | 31,594 | 1.29 | 1.08 | 0.0000 | 0.0000 |

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| 44 | Vaginal deliveries: % subsequent hospitalizations during puerperium | 490,592 | 476,691 | 0.58 | 0.48 | 94,331 | 89,814 | 0.83 | 0.67 | 0.0000 | 0.0000 |
| 45 | Vaginal parts: proportion of episiotomies | 261,212 | 243,310 | 10.66 | 12.27 | 5,068 | 4,169 | 10.03 | 9.66 | 0.0000 | 0.0000 |
| 46 | COPD exacerbation: mortality at 30 days | 34,334 | 28,200 | 12.57 | 13.57 | 5,068 | 4,169 | 10.78 | 11.25 | 0.0014 | |
| 47 | COPD flare-up: 30-day hospital readmissions | 29,768 | 24,525 | 12.44 | 12.06 | 4,526 | 3,891 | 10.78 | 11.25 | 0.0014 | |
| 48 | Chronic renal failure: mortality at 30 days after hospitalization | 96,641 | 93,357 | 14.83 | 14.12 | 9,436 | 8,623 | 12.85 | 10.83 | 0.0000 | 0.0000 |

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