

# Trend and variability in open and laparoscopic hysterectomies for patients with benign disease: a retrospective cohort study

Mario Saia<sup>1</sup>, Alessandra Buja<sup>2</sup>, Erich Cosmi<sup>3</sup>, Domenico Mantoan<sup>1</sup> and Vincenzo Baldo<sup>2</sup>

<sup>1</sup>Direzione Salute, Regione Veneto, Venice, Italy

<sup>2</sup>Laboratorio di Sanità Pubblica, Dipartimento di Medicina Molecolare, Università degli Studi di Padova, Padua, Italy

<sup>3</sup>Dipartimento di Salute delle Donne e dei Bambini, Università degli Studi di Padova, Padua, Italy

## Abstract

**Aim.** The aim of the present analysis on a regional hospital database was to ascertain the variability and 5-year trends of hysterectomy rates and the different surgical approaches used.

**Methods.** A retrospective cohort study was conducted in Veneto Region (North-East Italy), based on administrative data collected in 6 years, from 2009 to 2014.

**Results.** Our study showed an overall decline in the hospitalization rates for hysterectomy from 197.5 to 165.8/100 000 and shorter overall hospital stays for this procedure (from 5.5 to 4.5 days). During the six years analyzed, there was an overall increase in the use of laparoscopic surgery (from 28% to 35% of cases). There was also a marked variability within the region considered in terms of the hysterectomy rates and the type of procedure performed.

**Conclusions.** The unwarranted variability in the rates of elective surgical procedures, and the techniques used to perform them, could be monitored by analyzing electronic hospital records.

## Key words

- delivery of health care
- health care surveys
- hospital administration
- hysterectomy
- unwarranted variability

## INTRODUCTION

Hysterectomy is the major surgical procedure most often performed in gynecology [1, 2]. In recent times the hysterectomy rates have dropped in OECD countries, thanks to the adoption of these less invasive treatment procedures [3-6]. This has not happened to the same degree across different geographical areas, however. While the overall reduction seen in the number of hysterectomies performed might give the impression of an converging international clinical practice, high hysterectomy rates in certain geographical areas continue to raise questions about the appropriateness of care [7]. Most OECD countries also reveal two- to three-fold variations in their hysterectomy rates across geographical areas, which have tended to remain stable or even increase over time [7]. Such a geographical variability in hysterectomy rates and surgical approaches to this procedure may be a sign of inefficiencies or inequalities in healthcare provision [8]. Earlier research showed that medical issues could not justify all the differences observed [9, 10].

Hysterectomies can be performed vaginally, abdominally, or laparoscopically. The Cochrane review supports the conviction that, whenever feasible, vaginal hysterectomy is the safest and most cost-effective route by which to remove the uterus [11]. When a vaginal hysterectomy is impossible, laparoscopic hysterectomy has advantages over abdominal hysterectomy (including a faster return to normal activity, a shorter hospital stay, less intraoperative blood loss, and a lower risk of wound infection). Laparoscopic surgery is also associated with longer operating times, however, and with a higher risk of urinary tract injury. Despite the evidence emerging from various reports and the publication of guidelines [12], there are still considerable differences within and between countries as regards the chosen surgical route [6, 13, 14]. Hysterectomies for benign diseases are rarely performed under emergency conditions; so gynecologists should have enough time to complete each step in a standardized, rational clinical decision-making algorithm, relying on evidence-based guidelines to orient their choice of the best treatment

for a given patient and to avoid unwarranted variability. But elective treatments are often “preference-sensitive”, i.e. the decision as to which treatment (if any) is best depends partly on someone’s preference [15], as reported in other regional studies in the framework of general surgery [16-18].

One of the primary goals of public health policy exercised at national and regional level is to promote appropriate care while avoiding any unwarranted variability in its provision. The aim of this regional register-based study was to ascertain the variability and 6-year trend of hysterectomy rates and of the different surgical approaches used with a view to identifying the source of any unjustifiable variability.

## MATERIALS AND METHODS

This was a retrospective cohort study based on hospital records collected from 2009 to 2014 in the Veneto Region (north-east Italy). In Italy, regional authorities plan and organize health care facilities and activities through regional health departments in accordance with national health plans that are designed to guarantee a uniform provision of comprehensive care nationwide. They also coordinate and control local health authorities (LHA), each of which is a separate unit in the National Health System (NHS) that plans and delivers health care services to its local community, based on the regional health plan.

### Database

We considered the hospital discharge records (HDRs) for the years 2009-2014 concerning all public and accredited private hospitals in the region. These records contain personal details and information on hospital stays (date of admission and ward, date of discharge and ward, dates of any transfers between wards, and the wards involved, data on surgical procedures, and patients’ vital status at the time of discharge). The records indicate the main diagnosis at the time of discharge. Since the year 2000, all diagnoses and procedures have been classified according to the coding system of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM, 1997 version). All healthcare services are periodically assessed by a regional healthcare auditing service to check the consistency between patients’ clinical records and their hospital discharge records. The data considered here were provided by the Veneto Region’s Health Directorate.

### Data analysis

As defined by AHRQ quality indicators [19], we considered the following ICD-9-CM hysterectomy procedure codes: 68.3x, 68.4x, 68.5x, 68.6x, 68.7x, and excluded cases with genital cancer or pelvic or lower abdominal trauma in any diagnostic field, as well as MDC 14 (pregnancy, childbirth, and puerperium).

Concerning the surgical procedures, we recorded total or subtotal abdominal hysterectomies (AH) (ICD9CM 68.39, 68.49, 68.69, 68.9), laparoscopic hysterectomies (LH) (68.31, 68.41, 68.61), vaginal hysterectomies (VH) (ICD9CM 68.59, 68.79), and laparoscopy-assisted vaginal hysterectomies (LAVH) (68.51, 68.71). We

recorded the hysterectomy rates (HRs) for the region as a whole and for each LHA, calculated as the number of hysterectomies per 1000 women, where the numerator refers to hysterectomies performed in women aged 18 years or more, residing in the region, or a given LHA catchment area, and the denominator refers to women of the same age residing in each LHA of the region in 2011. The crude HR is influenced by the age distribution of the population. An age-standardized HR was estimated, using a direct standardization method, to analyze the temporal and spatial variability in the rates.

We performed a joinpoint regression analysis to identify significant changes in the yearly trends of the HR and of the length of hospital stays (LOS) [20]. For each of the trends identified, we also estimated the annual percent change (APC) by fitting a regression line to the natural logarithm of the rates using the calendar year as a regression variable. The average annual percent change (AAPC), based on an underlying joinpoint model, was calculated too, estimated as the geometric weighted average of the APCs with the weights equating to the length of each time interval segment.

Funnel plots were used to display the institution-related variability at LHA level, plotting the observed LHA-based percentages of VH out of the total volume of hysterectomies, and LAVH out of the total volume of vaginal hysterectomies, and superimposing 95% prediction limits  $\approx 2$  standard deviations on the overall regional rate.

The statistical analyses were performed using Excel and STATA 12 software.

### Details of ethics approval

The study was conducted on data routinely collected by the health services in anonymized records with no chance of individuals being identified. The data analysis was performed on aggregated data. All data in the LHA registries are recorded with the patient’s consent and can be used as aggregated data for scientific studies without further authorization [21]. The study complies with the Declaration of Helsinki and with the Italian Decree n. 196/2003 on the protection of personal data.

## RESULTS

During the period considered (2009-2014), there were 29 743 patients discharged from hospital after undergoing a hysterectomy. After excluding patients with genital malignancies (6073 cases, accounting for 20% of the total sample), those with MDC discharge code 14 (85 cases), and those under 18 years old (1 case), the study sample consisted of 23 584 discharge records for a total of 115 262 patient days (mean length of stay = 5 days). About overall cases, mainly cases were attributable to genital prolapse (43.7%) and leiomyoma (37.5%), followed by other female genital disorders (8.5%), including menstrual disorders (3.9%). An analysis of relative proportions of indications by year for surgery revealed that they did not vary with clinical significance from one year to another (data not shown).

Table 1 shows the distribution of hysterectomies by year and age group. Women aged between 45 and 54 years were the most often involved. No hysterectomies

**Table 1**

Trend of hysterectomy rates (HR) per 100 000 women and length of hospital stay (LOS), for benign gynecological conditions in the Veneto Region, by age group and year (2009-2014)

Age class	Total				2009			2010			2011			2012			2013			2014		
	n.	%	LOS	HR	n.	LOS	HR	n.	LOS	HR	n.	LOS	HR	n.	LOS	HR	n.	LOS	HR	n.	LOS	HR
25-34	73	0.3%	5.2	4.2	15	3.9	4.8	14	4.9	4.6	18	6.1	6.1	15	5.5	5.4	7	6.7	2.6	4	3.8	1.5
35-44	2982	12.6%	4.7	125.6	608	4.9	148.3	560	4.9	137.1	519	4.6	127.4	506	4.5	129.5	450	4.6	116.4	339	4.2	91.2
45-54	9379	39.8%	4.6	415.8	1592	5.3	455.5	1625	4.8	448.3	1681	4.5	447.3	1513	4.3	402	1480	4.4	382.8	1488	4.4	367.8
55-64	4218	17.9%	4.9	229.1	715	5.6	239	706	5.2	233.1	754	4.9	245.5	695	4.7	227	660	4.5	213.9	688	4.3	217.0
65-74	4738	20.1%	5.1	290.0	789	6	294.9	800	5.5	297.6	790	5.2	292	832	4.9	307.2	789	4.6	286.6	738	4.6	26.8
75-84	2029	8.6%	5.7	161.7	292	6.7	141.8	301	5.8	145.4	370	6.4	177.1	327	5.2	158.1	365	5.2	175.2	374	5.0	171.6
85 and over	165	0.7%	6.7	27.3	30	6.2	33.5	21	7	22.3	31	4.8	30.6	32	9.6	31.4	24	6.3	22.7	27	6.0	24.1
Total	23584	100%	4.9	185.6	4041	5.5	197.5	4027	5.1	193.4	4163	4.9	196.1	3920	4.7	185.9	3775	4.6	176.3	3658	4.5	165.8

were performed in the 18- to 25-year-old group. The HR for the period as a whole was 185.6 per 100 000 population, with evidence of a significant drop in the number of procedures performed each year (AAPC -3.39;  $p < 0.05$ ): in the last year analyzed, the HR was 165.8/100 000. The hospital stay also became gradually shorter, with a total reduction of one day of the 6-year period considered (AAPC -4.3;  $p < 0.05$ ).

Table 2 shows that, over the six years analyzed, the prevalent use of the vaginal as opposed to the abdominal route has been reversed and is now in favor of the latter: the proportion of abdominal procedures rose from 42% in 2009 to 55% in 2014 (AAPC + 4.4;  $p < 0.05$ ) due to an increase of laparoscopic abdominal intervention rose from 16% in 2009 to 31% in 2014, while the proportion of vaginal procedures dropped from 57% to 45% (AAPC - 4.1;  $p < 0.05$ ), mainly due to the decrease in LAVH from 12% in 2009 to 4% in 2014.

There was a marked geographical variability in the average HRs, which ranged from 86.5 to 262.0 across LHAs, as opposed to a mean rate of 185.6/100 000 at regional level. This variability was confirmed when we investigated the rates for the last year of the study

(2014): the regional HR had dropped significantly (165.8 procedures per 100 000 population), and the LHAs had rates that ranged between 75.1 and 249.3.

Figure 1 shows the between LHA variability in the type of procedure used.

Figure 2 shows the variability in the type of procedure used within and between each age group.

## DISCUSSION

### Main findings

Our study identified an overall drop in the hysterectomy rates and shorter hospital stays for this procedure.

Over the six years analyzed, there was evidence of an overall increase in the use of laparoscopic abdominal route. There was a marked within-region variability in the and a considerable age-related difference in the choice of surgical technique.

### Interpretation

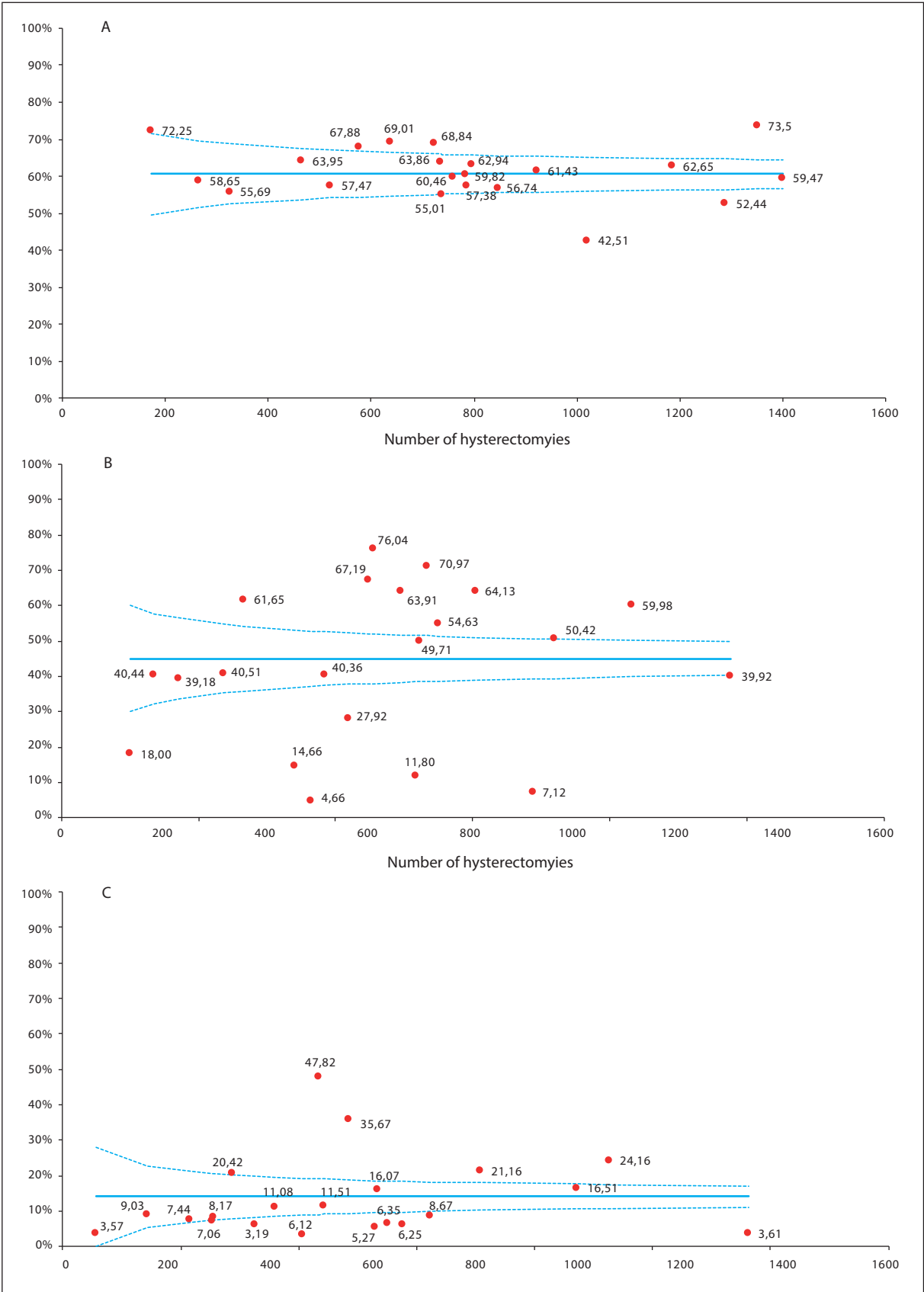
In the Veneto Region, the decline in the HR from 2009 to 2014, amounting to 31.7 fewer procedures per 100 000 population in six years. Several studies conducted on different populations have shown that the

**Table 2**

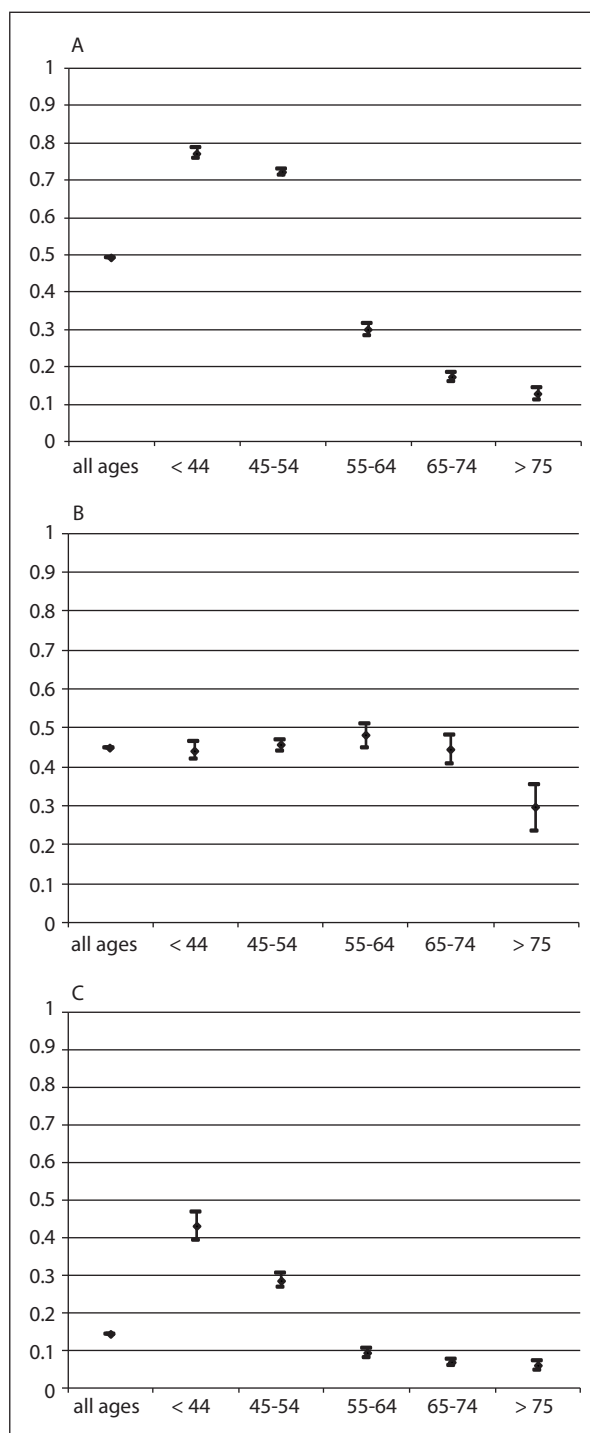
Trend of surgical approaches used for hysterectomy by year (2009-2014) in the Veneto Region

	2009			2010			2011			2012			2013			2014			Total		
	n.	%	L.S.	n.	%	L.S.	n.	%	L.S.	n.	%	L.S.	n.	%	L.S.	n.	%	L.S.	n.	%	L.S.
AH	1061	26%	6.5	997	25%	6.2	1007	24%	5.6	869	22%	5.5	868	23%	5.8	865	24%	5.7	4802	35%	5.9
Subtotal	102	10%	5.2	94	9%	4.6	87	9%	4.0	98	11%	3.9	120	14%	4.5	130	15%	4.3	501	10%	4.5
Total	959	90%	6.6	903	91%	6.4	920	91%	5.8	771	89%	5.6	748	86%	5.9	735	85%	5.9	4225	88%	6.1
LH	662	16%	4.5	931	23%	4.1	1088	26%	3.9	1183	30%	3.8	1099	29%	3.6	1132	31%	3.6	4963	25%	3.9
Subtotal	104	16%	4.0	102	11%	3.9	121	11%	3.6	136	11%	3.5	107	10%	3.5	125	11%	3.4	570	11%	3.7
Total	558	84%	4.5	829	89%	4.1	967	89%	3.9	1047	89%	3.8	992	90%	3.6	1007	89%	3.7	4393	89%	3.9
VH	1835	45%	5.6	1763	44%	5.2	1824	44%	5.1	1675	43%	4.8	1631	43%	4.6	1506	41%	4.4	8728	44%	5.1
LAVH	483	12%	4.5	336	8%	4.1	244	6%	4.4	193	5%	4.7	177	5%	4.3	155	4%	4.3	1433	7%	4.4
Total	4041	100%	5.5	4027	100%	5.1	4163	100%	4.9	3920	100%	4.6	3775	100%	4.6	3658	100%	4.5	19926		5.0
Non-laparoscopic	2896	72%	6.0	2760	69%	5.6	2831	68%	5.3	2544	65%	5.0	2499	66%	5.0	2371	65%	4.9	13530	68%	5.4
Laparoscopic	1145	28%	4.5	1267	31%	4.1	1332	32%	4.0	1376	35%	3.9	1276	34%	3.7	1287	35%	3.7	6396	32%	4.0

L.S.: Length of Stay; AH: abdominal hysterectomy; LH: laparoscopic hysterectomy; VH: vaginal hysterectomy; LAVH: laparoscopy-assisted vaginal hysterectomy.



**Figure 1**  
A: % Total or subtotal abdominal procedures among total hysterectomies by LHA  
B: % Laparoscopic procedures among abdominal hysterectomies by LHA  
C: % Laparoscopic procedures among vaginal hysterectomies by LHA

**Figure 2**

A: Fraction of total or subtotal abdominal procedures among hysterectomies by age group

B: Fraction of laparoscopic procedures among abdominal hysterectomies by age group

C: Fraction of laparoscopic procedures among vaginal hysterectomies by age group

HR has been declining in recent years [4, 5, 23, 24]. Several reasons for this have been suggested, primarily relating to the now widespread use of endometrial ablation devices and to a general trend towards a more

conservative, non-surgical management of many gynecological disorders.

These trends also have important implications for practicing gynecologists. Like hospital volumes, an overall decline in the HRs will be associated with physicians having lower case volumes. A study on laparoscopic hysterectomy found that 39% of women who underwent surgery between 2000 and 2006 were treated by a low-volume surgeon, as opposed to more than 50% in the years from 2007 to 2010 [24]. The study also suggested that hospital and surgeon volumes both have a clinically and statistically significant influence on peri-operative outcomes for women undergoing laparoscopic hysterectomy for benign gynecological conditions. Women treated by high-volume surgeons at high-volume hospitals have lower morbidity rates. Judging from all these findings, the HRs are apparently continuing to decline and these trends are likely to have an important influence on future gynecological practice. With this in mind, it is important to monitor the number of hysterectomies performed center by center and establish a minimum cut-off for accrediting a hospital to perform this type of surgery.

Different hysterectomy techniques can require different operating times and hospital stays, with differences in recovery time, pain, sexual function, quality of life, and costs as well [25]. We noted an increase in the use of LH and a corresponding decrease in the use of LAVH and AH, while the use of VH remained stable over the years considered. This change could be according to an evinced change in surgical approach: a recent meta-analysis suggested that whenever VH is feasible, it is preferable to AH, but even when VH is not feasible, a laparoscopic approach may avoid the need for abdominal hysterectomy. No evidence has been produced to support the benefits of laparoscopic over vaginal hysterectomy, however, and laparoscopic hysterectomy coincides with longer operating times and considerably more severe bleeding.

Although no international benchmarks have been established for HRs, our findings reveal sizable, unexplained geographical differences in the use of this procedure. This variability has significant implications for health care policy. Several studies have shown that different HRs between different geographical areas cannot be explained by any underlying patterns of disease. For instance, the rates vary between different jurisdictions in Australia [26], and in the USA [27]. A study conducted in the USA [28] also found that hysterectomy was often (in as many as 76% of cases) recommended for inappropriate indications. Significant differences in the use of this procedure emerged in our region too, suggesting an excessive use of hysterectomy for women living in some parts of the Veneto and suggests that whether or not a woman will receive a particular health service depends to a very great extent on the LHA where she lives within the Region. Further investigations, analyses and strategies are needed, particularly to ensure that women are well informed and can access appropriate options wherever they live. At Italian national level since 2008, the National Outcomes Programme (NOP), official tool to assess the National Health System, evaluating out-



comes of care of the Italian hospitals; showed a stable national in hysterectomies rates by year (167/100 000 in 2014) but an high inter regional-variability (from 107/100 000 to 215/100 000) [29].

The great variability in the surgical technique used by the Veneto Region's various LHAs over a six-year period confirms previous reports that, despite the available evidence, the choice of surgical approach is probably influenced mainly by the surgeon's experience and training, or by well-established, preferred practices at a given gynecology ward, *i.e.* this variability reflects local clinical practice [30]. For the most part, patients are left in the dark about any differences of opinion between clinicians, and in many cases even about the paucity of clear clinical evidence to support one choice rather than another. They consequently defer to their clinicians in the belief that the "doctor knows best", unaware that this may not be the case.

When patients are not well informed and not involved in decisions concerning their treatment, their clinicians' preferences and opinions can strongly influence the rates of elective procedures performed in a given community [15]. In some places, a single group of physicians may contribute to inducing a marked variation in the use of a particular procedure. Differences in the rates of preference-sensitive care that are not justified by the prevalence of a given disease or by patients' preferences are considered unwarranted. Our study also showed that such patterns of unwarranted variability tend to persist over time, despite a reduction in the overall HR in our region. Better clinical guidelines could help to reduce this unwarranted variability. More efforts to disseminate the results of comparative studies would also help clinicians to distinguish between the pros and cons of different treatment options, enabling them to offer their patients better advice and thereby reduce the inappropriate use of certain procedures. Improving the transparent exchange of data between health care providers regarding their usage of certain procedures is another way to help curb the unwarranted variability in health care provision. When surgeons and clinicians are made aware of how the rates vary by geographical area, they may be prompted to examine their own practices with those of others and take steps to adjust any over- or under-use of certain treatments or procedures [31]. In an example of this, noted by J. Wennerg, when the leadership of a hospital for the Lewiston area imposed a quota to bring its HR down to the national average, the rate at which women in Lewiston had hysterectomies dropped by 45%, and this rate remained stable over time [32]. It is worth adding at this point that a greater transparency does not necessarily mean that patients receive the care they prefer. Studies suggest that a high rate of use of a given procedure in a given community does not necessarily mean that all

appropriate candidates, or patients wanting said procedure, are actually getting it, just as a low rate does not mean that inappropriate candidates, or patients who do not want the procedure, are avoiding it [33].

Our study also identified age-related disparities in the choice of surgical approach for hysterectomy. Although the types of disease prompting the surgical procedure differed by age group to some extent and possible other concerns, for example difference in tolerating Trendelenburg position, the evidence-based guidelines do not recommend different surgical approaches for patients of different ages. Our findings confirmed those of a previous report that women under 35 years old were more likely to undergo laparoscopic hysterectomy than older women [34].

### Strengths and limitations

This study has some limitations. We were unable to explore the influence of the staff's characteristics in more detail because the database's statistical unit is the LHU, but a given LHU may include several hospitals, and a given hospital may have more than one surgery ward. Be that as it may, analyzing aggregate clinical data is a powerful tool for regional health system managements striving to improve the quality of medical care, enabling them to assess the appropriateness of therapeutic or diagnostic approaches in the light of practical guidelines. Any variability in therapeutic approaches to a given disease that lacks any evidence-based justification remains an important issue in national health systems.

### CONCLUSION

It is important to address the problem of unwarranted differences in hysterectomy rates and the techniques used to perform them, and monitoring such activities by analyzing hospital databases could help to ensure that patients get the most appropriate care.

### Contribution to authorship

Mario Saia conceived the study design and analyses the data and wrote the paper; Alessandra Buja analyzed data and wrote paper; Eric Cosmi assisted in the interpretation and comment of the results; DM furnished data and conceived the study design and, Vincenzo Baldo supervised all study and manuscript work phases.

### Funding and acknowledgment

There was no funding for this study, it was a spontaneous study.

### Conflict of interest statement

No conflicts of interest to declare.

Received on 11 March 2016.

Accepted on 28 February 2017.

### REFERENCE

1. Lefebvre G, Allaire C, Jeffrey J, et al. SOGC Clinical Guidelines. Hysterectomy. *J Obstet Gynaecol Can* 2002;24:37-61.
2. Carlson KJ, Nichols DH, Schiff I. Indications for hysterectomy. *N Eng J Med* 1993;328:856-60.
3. Jacobson GF, Shaber RE, Armstrong MA, Hung YY.

- Hysterectomy rates for benign indications. *Obstet Gynecol* 2006;107(6):1278-83.
4. Lundholm C1, Forsgren C, Johansson AL, Cnattingius S, Altman D. Hysterectomy on benign indications in Sweden 1987-2003: a nationwide trend analysis. *Acta Obstet Gynecol Scand* 2009;88(1):52-8. DOI: 10.1080/00016340802596017
  5. Whiteman MK, Hillis SD, Jamieson DJ, et al. Inpatient hysterectomy surveillance in the United States, 2000-2004. *Am J Obstet Gynecol* 2008;198:34.e1-7.
  6. Nielsen SL, Daugbjerg SB, Gimbel H, Settnes A. The steering committee of the Danish hysterectomy database. Use of vaginal hysterectomy in Denmark: rates, indications and patient characteristics. *Acta Obstet Gynecol Scand* 2011;90:978-84.
  7. McPherson K, Gon G, Scott M. *International variations in a selected number of surgical procedures*. OECD Health Working Papers, No. 61. Paris, France: OECD; 2011. DOI: 10.1787/5k49h4p5g9mw-en
  8. Organisation for Economic Co-operation and Development. *Geographic variations in health care: what do we know and what can be done to improve health system performance?* OECD Health Policy Studies. Paris, France: OECD; 2014. DOI: 10.1787/9789264216594-en
  9. Matera E, Rossi L, Spadea T, Cacciani L, Baglio G, Cesaroni G, Arcà M, Perucci CA. Hysterectomy and socioeconomic position in Rome, Italy. *J Epidemiol Commun Health* 2002;56(6):461-5.
  10. Gimbel H, Ottesen B, Tabor A. Danish gynaecologists' opinion about hysterectomy on benign indication: results of a survey. *Acta Obstet Gynecol Scand* 2002;81(12):1123-31.
  11. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, van Voorst S, Mol BWJ, Kluivers KB. *Surgical approach to hysterectomy for benign gynaecological disease*. Cochrane Database of Systematic Reviews 2009, Issue 3. Art. No.: CD003677. DOI: 10.1002/14651858.CD003677.pub4
  12. Lefebvre G, Allaire C, Jeffrey J, Vilos G, Arneja J, Birch C, Fortier M. Clinical Practice Gynaecology Committee and Executive Committee and Council, Society of Obstetricians and Gynaecologists of Canada. SOGC Clinical Guidelines. Hysterectomy. *J Obstet Gynaecol Can* 2002;24(1):37-61.
  13. Istre O, Langebrekke A, Qvigstad E. Changing hysterectomy technique from open abdominal to laparoscopic: new trend in Oslo, Norway. *J Minim Invasive Gynecol* 2007;14:74-7.
  14. Bottle A, Aylin P. Variations in vaginal and abdominal hysterectomy by region and trust in England. *BJOG* 2005;112(3):326-8.
  15. California Healthcare Foundation. *All over the map: elective procedure rates in California vary widely*. 2014. Available from: [www.chcf.org/~media/MEDIA%20LIBRARY%20Files/PDF/V/PDF%20VariationResearchSummary2013.pdf](http://www.chcf.org/~media/MEDIA%20LIBRARY%20Files/PDF/V/PDF%20VariationResearchSummary2013.pdf)
  16. Saia M, Buja A, Baldovin T, Callegaro G, Sandonà P, Mantoan D, Baldo V. Trend, variability, and outcome of open vs. laparoscopic appendectomy based on a large administrative database. *Surg Endosc* 2012;26(8):2353-9. DOI: 10.1007/s00464-012-2188-5. Erratum in: *Surg Endosc* 2014;28(5):1752.
  17. Saia M, Mantoan D, Buja A, Bertoncello C, Baldovin T, Callegaro G, Baldo V. Time trend and variability of open versus laparoscopic cholecystectomy in patients with symptomatic gallstone disease. *Surg Endosc* 2013;27(9):3254-61. DOI: 10.1007/s00464-013-2902-y
  18. Saia M, Buja A, Sartor G, Mantoan D, Agresta F, Baldo V. Colon cancer surgery: A retrospective study based on a large administrative database. *Surg Laparosc Endosc Percutan Tech* 2016;26(6):e126-31.
  19. Agency for Healthcare Research and Quality (Quality Indicators). *Inpatient quality indicators 28: technical specifications*. Hysterectomy rate [version 4.4]. Rockville (MD): AHRQ; 2012. p. 2.
  20. National Cancer Institute. *Joinpoint regression program. Statistical methodology and applications branch and data modeling branch, surveillance research program 3.5.11*. Available from: <http://srabcancer.gov/joinpoint/>
  21. Garante per la protezione dei dati personali. Deliberazione n. 85 del 1 marzo 2012. GU n. 72, 26 marzo 2012.
  22. Parazzini F, Ricci E, Bulfoni G, Cipriani S, Chiaffarino F, Malvezzi M, Frigerio L. Hysterectomy rates for benign conditions are declining in Lombardy, Italy: 1996-2010. *Eur J Obstet Gynecol Reprod Biol* 2014;178:107-13. DOI: 10.1016/j.ejogrb.2014.04.024
  23. Wright JD, Herzog TJ, Tsui J, Ananth CV, Lewin SN, Lu YS, Neugut AI, Hershman DL. Nationwide trends in the performance of inpatient hysterectomy in the United States. *Obstet Gynecol* 2013;122(2 Pt 1):233-41. DOI: 10.1097/AOG.0b013e318299a6cf
  24. Wallenstein MR1, Ananth CV, Kim JH, Burke WM, Hershman DL, Lewin SN, Neugut AI, Lu YS, Herzog TJ, Wright JD. Effect of surgical volume on outcomes for laparoscopic hysterectomy for benign indications. *Obstet Gynecol* 2012;119(4):709-16. DOI: 10.1097/AOG.0b013e318248f7a8
  25. Clayton RD. Hysterectomy. *Best Pract Res Clin Obstet Gynecol* 2006;20(1):73-87.
  26. Australian Council for Safety and Quality in Health Care and the National Institute of Clinical Studies. *Charting the safety and quality of health care in Australia*. Canberra, Australia: ACSQHC; 2004. Available from: [www.safety-andquality.gov.au/wp-content/uploads/2012/01/finlchrt-bk16305.pdf](http://www.safety-andquality.gov.au/wp-content/uploads/2012/01/finlchrt-bk16305.pdf)
  27. Agency for Healthcare Research and Quality. *Hysterectomy: hysterectomy area rate*. Available from: [www.qualitymeasures.ahrq.gov/content.aspx?id=38505](http://www.qualitymeasures.ahrq.gov/content.aspx?id=38505)
  28. Broder MS, Kanouse DE, Mittman BS, Bernstein SJ. The appropriateness of recommendations for hysterectomy. *Obstet Gynecol* 2000;95(2):199-205.
  29. Ministero della Salute. *Programma Nazionale Esiti 2015*. Available from: <http://95.110.213.190/PNEed15/index.php>
  30. Stacey D, Bennett CL, Barry MJ, Col NF, Eden KB, Holmes-Rovner M, Llewellyn-Thomas H, Lyddiatt A, Légaré F, Thomson R. Decision aids for people facing health treatment or screening decisions. *Cochrane Database of Systematic Reviews*, 2011 (10). DOI:10.1002/14651858.CD001431.pub3
  31. Sipkoff M. 9 ways to reduce unwarranted variation. *Manag Care* 2003;12(11):20-4, 27-8, 30 passim.
  32. John E, Wennberg A. *Researcher's quest to understand health care. Tracking medicine*. Oxford: Oxford University Press; 2010.
  33. Lucas FL, De Lorenzo MA, Siewers E, Wennberg DE. Temporal trends in the utilization of diagnostic testing and treatments for cardiovascular disease in the United States, 1993-2001. *Circulation* 2006;113(3):374-9. DOI: 10.1161/CIRCULATIONAHA.105.560433
  34. Patel PR, Lee J, Rodriguez AM, Borahay MA, Snyder RR, Hankins GD, Kilic GS. Disparities in use of laparoscopic hysterectomies: a nationwide analysis. *J Minim Invasive Gynecol* 2014;21(2):223-7. DOI: 10.1016/j.jmig.2013.08.709