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Original article

Cancer prevention and public health

Linking payment to volume – does it work in oncological surgery in Poland?

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Introduction. This study aims to evaluate the impact of a new financing policy (25% bonus) on the centralization of radical surgical procedures for cancer treatment in high-volume hospitals in Poland. It builds on existing research that demonstrates a positive correlation between treatment outcomes and the volume of patients managed at a center, extending to various cancer types and treatment modalities including both surgical and non-surgical approaches.

Material and methods. Reimbursement data was collected about all radical surgery procedures related to cancer treatment funded from public sources in Poland in 2019–2022. Hospitals were clustered in three groups: 1) high-volume, 2) "close to" high-volume, and 3) low-volume hospitals. To assess the maximum number of providers in each type of cancer surgery, the volume procedures for low-volume hospitals was recalculated.

Results. In the years 2018–2022, over 450 hospitals provided radical surgery services in the 13 cancer groups studied. This value changed slightly during the period under study. In almost half of the analyzed cancer groups, the number of low-volume hospitals is increasing. An increasing number of hospitals are providing services below the thresholds. At the same time, across almost all studied groups, the number of high-volume hospitals also increased. Analysis of the distribution of services by clusters proves the gradual concentration of the market. The share of radical surgery services provided by low-volume hospitals decreased from 39% in 2019 to 35% in 2022. The share of services provided in high-volume hospitals increased gradually from 49% to 57% (highest for prostate, kidney and thyroid cancers).

Conclusions. The financial model providing additional revenue for high-volume hospitals with additional requirements regarding the treatment process, as well as having no required minimal volume of procedures, induced the centralization of radical oncology surgery only insignificantly.

Key words: financial incentives, high volume hospitals, cancer surgery, reimbursement

Introduction

For many cancer types, survival as well as outcomes are improved when patients receive management at treatment centers that encounter high numbers of patients annually. Studies have researched and confirmed a relationship between surgeon volume and improved health outcomes for high-risk surgical procedures in oncology. Other studies show that higher hospital surgery volumes are also associated with better outcomes compared to low-volume hospitals [1]. Some research even shows that greater hospital volume can be a substitute for surgeon's individual experience, by transferring the organizational learning curve [2]. This correlation is specifically important for

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less common diseases and tumors when patients benefit from being treated in high-volume centers [3].

The research on volume-outcome associations have been held on numerous types of cancer procedures, both resections as well as reconstructions: colon cancer [4, 5], colorectal surgery [6], rectal surgery [7–9], pancreatic or esophageal cancer resections or free tissue transfer [10], breast cancer surgery [9], lung cancer [11]. Also research on nonsurgical treatment of oncology patients has shown improved survival for treatment in high-volume hospitals [12, 13].

Improved outcomes are associated with clinical outcomes such as mortality, short-term and medium-term survival, in-hospital death, complications, or length of stay. This is confirmed for different types of oncological surgery, including laparoscopy [5, 6] and robotic surgery [14]. Other research shows that lower number of complications is positively associated with lower costs of cancer nonsurgical treatment [15, 16].

As a consequence of the evidence on volume-outcome associations, efforts have been made in several countries and areas to introduce regulation on minimum volume or other means to promote centralization [17]. Such a policy has also been introduced in Poland in oncological surgery – it differentiates prices for treatment, with higher prices granted to high-volume hospitals. The research on the effects of such policies is still relatively limited and new. Hospitals' reaction can differ depending on factors such as the distance that the patient has to the nearest high-volume hospital as well as the hospital's capacity.

The aim of the study was to analyze the impact of the new financing policy on the centralization of the procedures of radical surgery in cancer treatment to high-volume hospitals in Poland. This analysis focuses on the primary outcome of whether the radical surgery was concentrated at high-volume hospitals compared to the situation before the financial mechanism was introduced.

Material and methods

Overview of oncological package and selection of primary outcome

The oncology package was the first approach in Poland to coordinated care of cancer patients. The primary goal of this reform was to improve treatment results by shortening the time from suspicion of cancer to the initiation of treatment, and to provide comprehensive care at every stage of the disease (using the Diagnostics and Oncological Treatment Card, hereinafter: DiLO).

The oncology package introduced maximum deadlines for oncological diagnostics, and defined requirements for healthcare providers to ensure a quick and comprehensive service of a specific standard. Healthcare providers were obliged to provide access to several diagnostic tests as part of oncological diagnostics at the level of outpatient specialist care within a specified period (28 days to conduct preliminary diagnostics in order to confirm or exclude cancer; another 21 days to conduct comprehensive diagnostics in order to determine the type, stage and location of the cancer). During hospital treatment (which should be commenced within 14 days), it was necessary to conduct a medical consultation panel and provide access to all cancer treatment methods, i.e. surgical treatment, chemical treatment and radiotherapy [18]. Economic incentives were also used to increase the efficiency of the diagnostic and treatment process.

The concept of a "leading center" was also introduced. One of the conditions for such a center was to have a surgical ward (this condition does not apply to malignant tumors of the hematopoietic or lymphatic system) [19]. The aim was to induce centralization of dispersed surgical practice. Access to radiotherapy and chemotherapy could be guaranteed through a cooperation agreement or subcontracting.

In 2018, the National Health Fund introduced financial mechanisms. The goal was to strengthen the concentration of providers. Hospitals specializing in performing specific surgical procedures to oncology patients (with a DiLO card) were granted higher prices for their services. The 25% bonus was granted to hospitals that exceeded the threshold for the volume of procedures in a given cancer group (tab. I) and provided these services within DiLO conditions.

Study period

We used NFZ reimbursement data from January 1, 2019, through December 31, 2022. We defined the starting point as

Table I. Volumes of radical surgery procedures that entitle higher prices – 2018 year

Cancer type	Volumes of radical surgery procedures
lung cancer	70
urinary bladder cancer	30
ovarian cancer	30
colorectal cancer	75
uterine cancer	60
kidney cancer	50
breast cancer	250
prostate cancer	75
pancreatic cancer	30
stomach cancer	30
thyroid cancer	75
central nervous system cancer	150
throat cancer	50

Source: Ordinance No. 87/2018/DSOZ of the President of the National Health Fund of August 23, 2018, amending the order on determining the conditions for concluding and implementing contracts such as hospital treatment and hospital treatment – highly specialized services

the first year after the "25% plus for high-volume hospitals" financial mechanism was introduced. The intervention was introduced on July 1, 2018, for all hospitals. Recognizing that it takes time to redesign clinical care and optimize performance in a new payment model, we have analyzed the data starting from the first full year after the new model was introduced to the last available period, which was 2022.

Radical surgery in cancer treatment

We included all radical surgery procedures related to the cancer treatment for which the "25% plus for high-volume hospitals" mechanism was introduced. We included only hospitals which provided treatment funded by the NFZ, the only public payer. These are almost all the procedures provided in Poland, as hospital treatment is hardly ever funded from private sources [20]. NFZ reimbursement data was obtained for each provider and contained information about principal discharge diagnoses (ICD-10), provided procedures (ICD-9 CM) and financing type (oncological package/not oncological package).

Hospitals were clustered in three groups: 1) hospitals granted a 25% high-volume benefit, 2) "close to" high-volume hospitals i.e. hospitals providing sufficient volume of procedures to be granted the benefit but not fulfilling the other criteria for the oncological package, and 3) low-volume hospitals.

To assess the maximum number of providers in each type of cancer surgery, we recalculated the number of procedures provided by providers in low-volume hospitals and divided them by surgery threshold value for defined cancer type.

Results

Change in the number of hospitals

In the years 2018–2022, over 450 hospitals provided radical surgery services in the 13 cancer groups studied (tab. II). This value changed slightly during the period under study. The largest number of providers were observed in procedures involving colorectal cancer (416 in 2019). At the same time, the largest decrease in their number was observed within this treatment group (a drop of 24 centers in 2022). A similar decline (22 centers) was observed in the case of radical surgery for stomach cancer. However, the highest relative decrease (by 11%) was recorded for breast cancer – out of 176 hospitals reporting services in 2019, 156 were recorded in 2022. A reduction in the number of hospitals (by 2) was also observed in kidney cancer. In the remaining locations, there were no changes (ovarian cancer, lung cancer) or an increase in the number of hospitals (throat cancer, prostate cancer, uterine cancer, central nervous system cancer, urinary bladder cancer, thyroid cancer and pancreatic cancer).

In the case of almost half of the analyzed cancer groups (i.e. throat cancer, kidney cancer, central nervous system cancer, urinary bladder cancer, thyroid cancer and pancreatic cancer), an increasing number of hospitals are providing services below the thresholds (fig. 1). At the same time, in almost all studied groups (except for pancreatic cancer), the number of hospitals providing services above the required threshold increased. This is not the result of the emergence of new service providers but the reorganization of service providers who were previously in the "potentially above the threshold" category, i.e. providing services in a volume exceeding the required threshold but not meeting the conditions of the DiLO card (probably due to the inability to provide consultation or meet the deadlines for diagnosis and initiation of treatment).

Table II. Number of hospitals by cancer type

Cancer type	Year and number of hospitals			
	2019	2020	2021	2022
throat	88	92	93	95
prostate	132	135	137	135
ovarian	178	183	175	178
colorectal	416	418	394	392
uterine	245	249	248	248
kidney	179	186	183	177
central nervous system	78	79	81	82
urinary bladder	133	140	137	139
breast	176	167	155	156
lung	36	41	40	36
thyroid	172	162	176	191
pancreatic	117	127	122	119
stomach	272	261	250	250
total	471	475	456	455

Source: "Healthy Data" website, published by eHealth Center

The degree of concentration of the market for radical surgery procedures

Analysis of the distribution of the number of services by category of hospitals proves the gradual concentration of the market (tab. III). The share of radical surgery services provided by hospitals not meeting the threshold decreased from 39% in 2019 to 35% in 2022. During the period under review, the share of services provided by hospitals in the "potentially above the threshold" category also decreased by 3 percentage points. In turn, the share of services provided in hospitals above the threshold increased gradually from 49% to 57%. On the other hand, it can be stated that more than 40% of services are still provided by hospitals below the threshold.

Concentration of procedures in large centers is observed in all (except for pancreatic cancer) examined cancer groups (fig. 2). In the case of radical surgery for prostate, kidney and thyroid cancers, the increase in the share of services provided by high-volume hospitals was 15 percentage points, 14 percentage points and 12 percentage points, respectively.

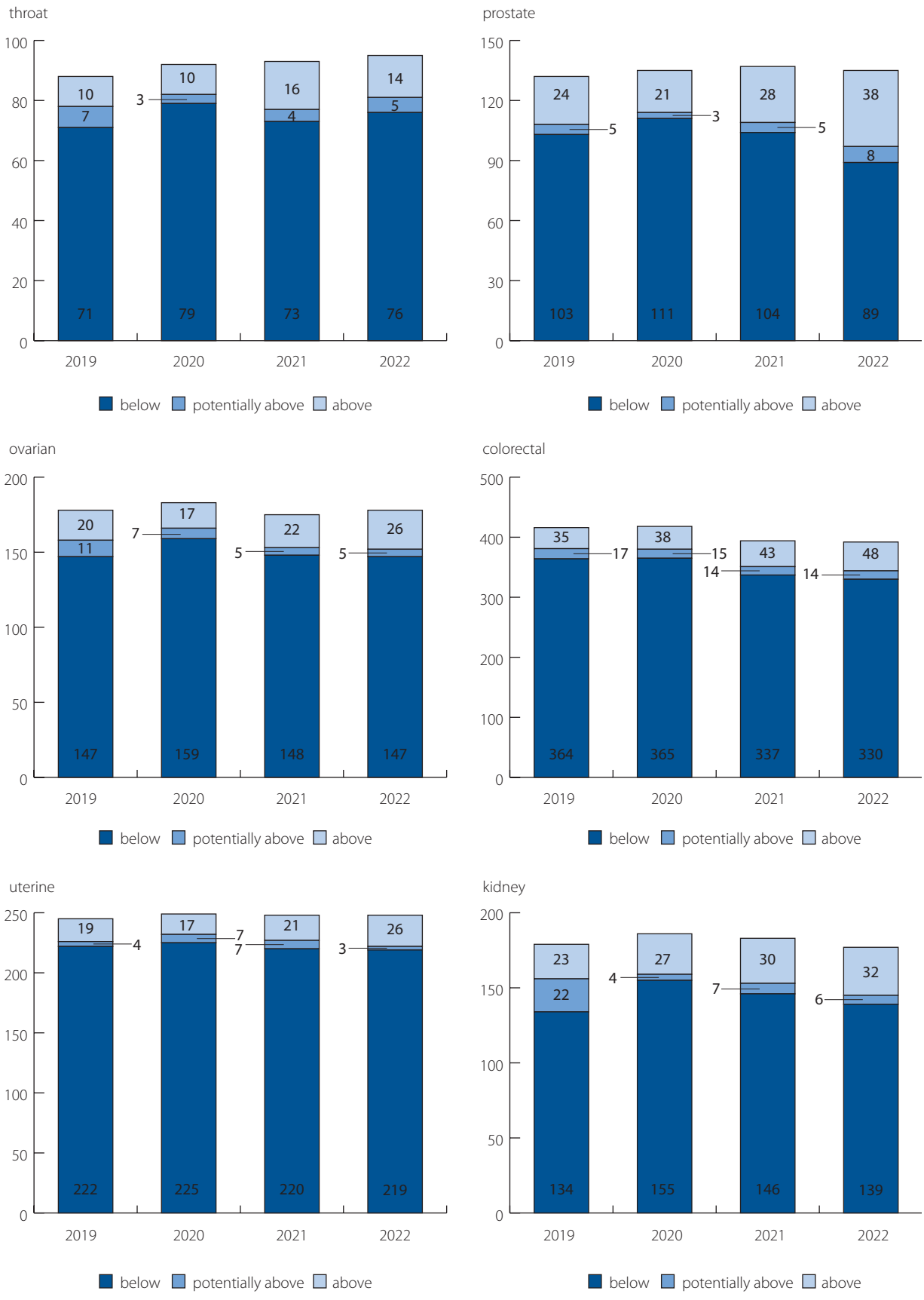

Figure 1. Number of hospitals by cancer group and category

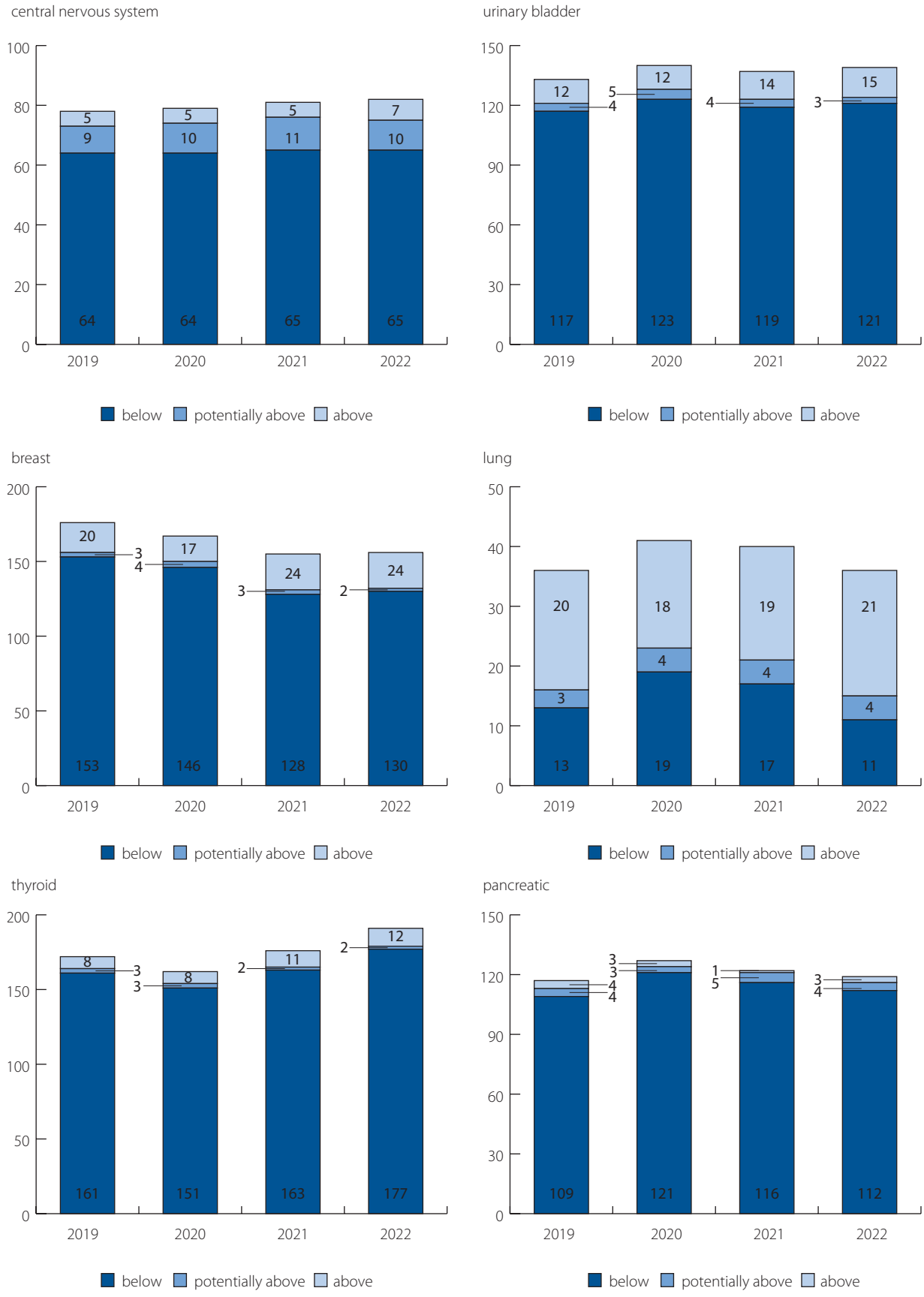

Figure 1 cont. Number of hospitals by cancer group and category

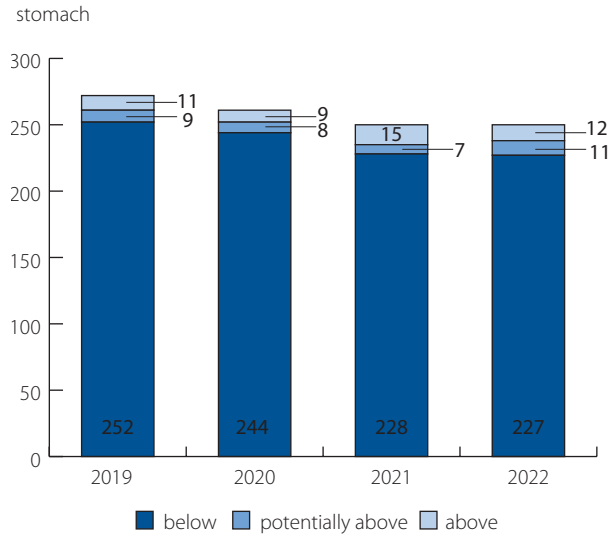

Figure 1 cont. Number of hospitals by cancer group and category

*above the threshold – the volume of procedures performed as part of the oncological package or comprehensive oncological care was at least equal to the threshold value; potentially above the threshold – the volume of procedures was at least equal to the threshold value, regardless of the scope of services in which it was reported; below threshold – the volume of treatments below the threshold value. Source: own calculation based on "Healthy Data" website, published by eHealth Center

Table III. Number of radical surgeries by hospital category

Year	Total	Below the threshold		Potentially above the threshold		Above the threshold	
2019	76,884	30,303	39%	9,271	12%	37,310	49%
2020	69,074	28,820	42%	7,308	11%	32,946	48%
2021	75,098	26,832	36%	7,516	10%	40,750	54%
2022	82,975	28,714	35%	7,229	9%	47,032	57%

Source: own calculation based on "Healthy data" website, published by eHealth Center.

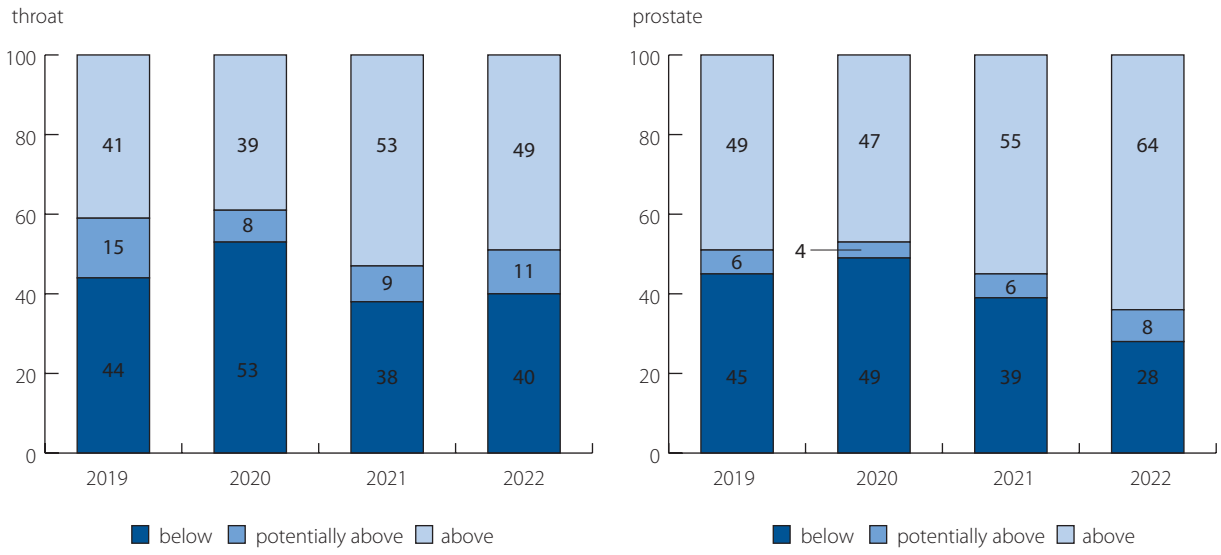

Figure 2. Structure of surgeries by cancer group and hospital category

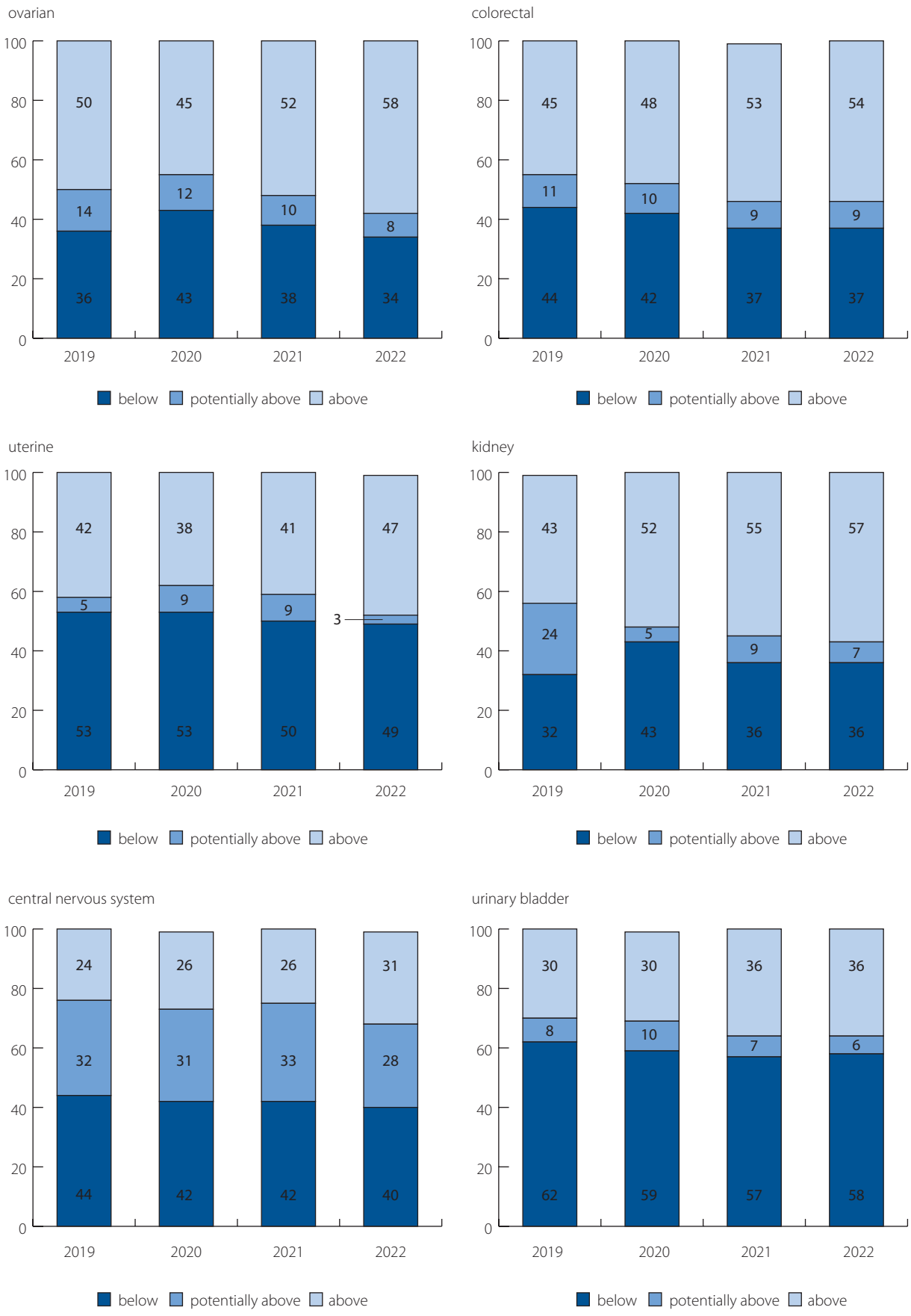

Figure 2 cont. Structure of surgeries by cancer group and hospital category

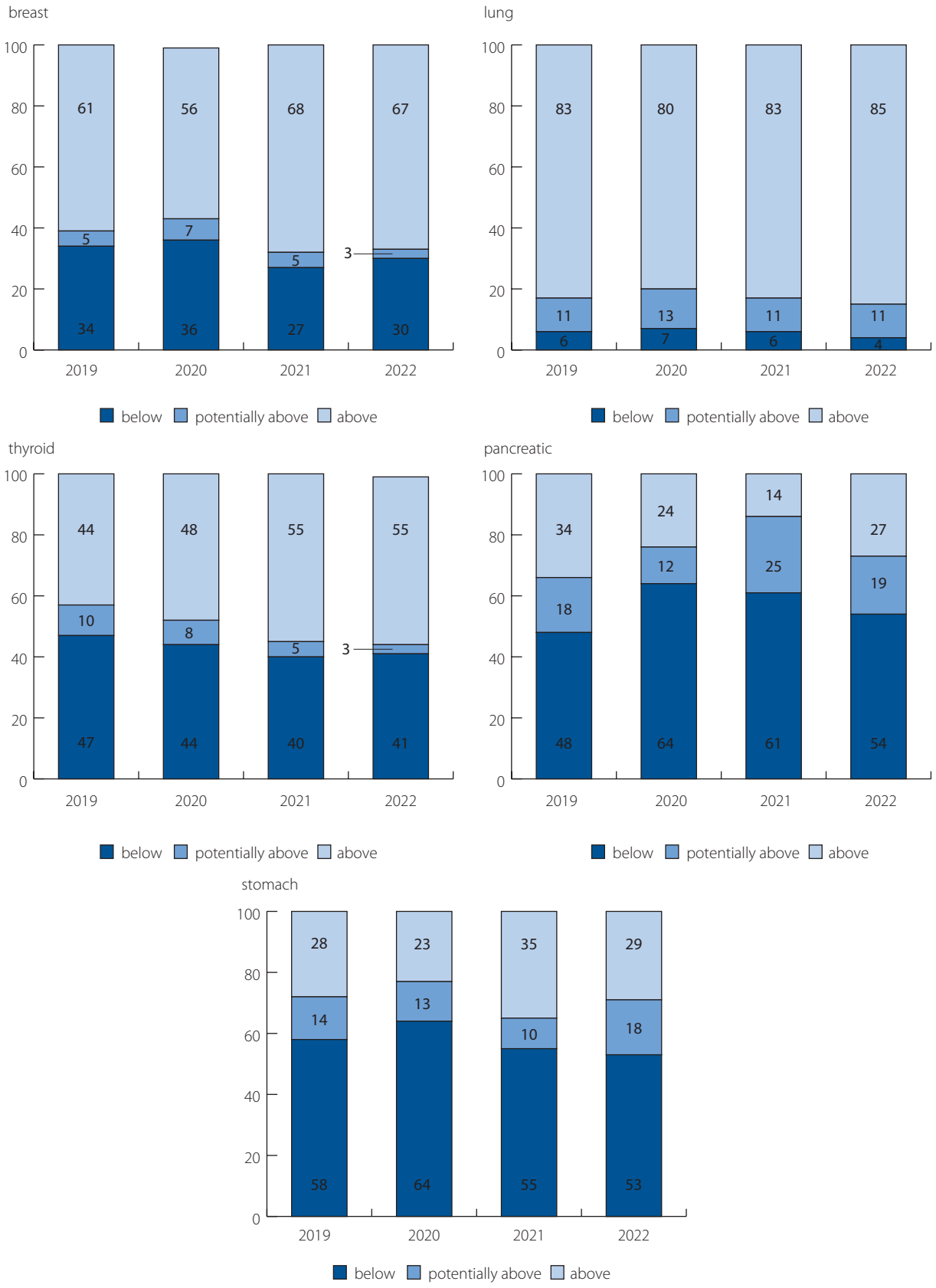

Figure 2 cont. Structure of surgeries by cancer group and hospital category

Source: own calculation based on "Healthyd" website, published by eHealth Center

Table IV. Number of hospitals providing radical surgeries and projection* by cancer type (2022 year)

Cancer type	2022	2022*	Difference
throat	95	38	–57
prostate	135	80	–55
ovarian	178	62	–116
colorectal	392	133	–259
uterine	248	81	–167
kidney	177	80	–97
central nervous system	82	37	–45
urinary bladder	139	56	–83
breast	156	48	–108
lung	36	28	–8
thyroid	191	40	–151
pancreatic	119	27	–92
stomach	250	66	–184

*max number of hospitals i.e. assuming that hospitals below threshold provide number of services accounted to threshold (ceteris paribus). Source: own calculation based on "Healthy data" website, published by eHealth Center

In turn, small increases (at the level of 1 pp or 2 pp) were observed among procedures performed in lung cancers and stomach cancers. In the remaining groups the increase was 6 pp–9 pp.

Considering the number of services provided in hospitals that do not meet the volume threshold, it should be concluded that across all cancer groups the number of healthcare providers providing radical surgery should be limited (tab. IV). The biggest changes should concern healthcare providers performing procedures in colorectal cancer surgery – a reduction to 133 healthcare providers in the country instead of the current number of 392.

Discussion

The implemented solution of determining the threshold above which a hospital qualifies as high-volume is a solution used in some countries, since several studies show positive clinical outcomes related to cancer treatment in high-volume hospitals – emphasising it especially for the most complicated, rare procedures. Individual countries differ in how they implement this solution, which largely depends on the type of healthcare system. Some countries, especially those dominated by publicly financed health care, have introduced more strict regulatory procedures [21]. For example, researchers in the German sector have determined minimum thresholds for treatment procedures that ensure better outcomes [22]. However, solutions defining volume thresholds also exist in the United States [23].

The example of Johns Hopkins Hospital or the Leapfrog Group have illustrated effective actions toward increasing the share of individual hospitals in the total number of procedures. The analysis conducted for Poland did not show such strong effects in the examined period (four consecutive years after the implementation of the change). The reason for the weak consolidation effect may be an insufficiently large financial incentive that constitutes a real incentive for hospitals to increase the volume of activities. The reasons may also be organizational – large hospitals may not have sufficiently large resources to be able to consume a significant increase in the number of services. Additionally, some hospitals may fail to meet the organizational conditions for the DILO card. The additional financing may not cover the costs related to the reorganization of the treatment process to meet the deadlines for starting treatment or implementing counseling.

On the other hand, the solution used in Poland introduces an incentive for high-volume hospitals, while at the same time there are no entry barriers for hospitals performing fewer procedures, preventing them from entering the market. What is important is that oncology had no budget cap before – all services provided were financed. The solution of excluding from the market providers with fewer than the required number of procedures is used in Poland, for example, in relation to arthroplasty procedures; it is justified by the learning curve and the need to continuously provide services to maintain high quality.

Additionally, it is the patients and their referring doctors who decide on where the surgery is performed. Educating and informing patients and referring doctors on hospital volumes and outcomes for different procedures would be useful. Public dissemination of performance data is already under way in some countries [21]. In Poland, data on the number of services is available in the payer's information system as well as on the "Healthy data" website, but they do not constitute a source of information for patients or doctors considered when choosing the hospital performing the procedure.

In healthcare systems in which patients are free to choose where to be treated, understanding patients' behavior and what drives them towards the most effective choice is of paramount importance. As Italian research shows, the distance to hospitals is among the most significant factors that play a role in the patient decision process. The same research has shown, however, that patients affected by comorbidities are more responsive to hospital quality and less to distance [24].

A policy of centralization of the most complex cancer surgery may lead to improved outcomes, and therefore, the introduction of financial or institutional incentives is justified. As shown by Ciesielski et al., the specialization of the surgical department on surgical oncology improves the outcomes [25]. Efforts should focus on optimizing the balance between patient access to specialty care and the experience of the treating center [12]. Perhaps improving the care coordination (e.g. providing post-hospitalization care closer to home) would be an important facilitator of the surgery centralization process.

The dispersion of radical oncological surgery procedures in Poland may be partly because doctors work in more than

one hospital and perform surgical procedures in each facility. According to the "Maps of health needs", the average number of jobs for doctors specializing in oncological surgery in 2019 was 1.78, for thoracic surgeons – 2.08, and for general surgeons – 1.61 [26]. This means that the surgeon's experience often goes beyond the experience acquired in each hospital. At the same time, however, research on the importance of volume of procedures performed in a given hospital indicates that this relationship is complex. A study by Harmon et al. [2] indicated that medium-volume surgeons achieved excellent outcomes similar to high-volume surgeons when operating in medium--volume or high-volume hospitals, but not in low-volume hospitals. As shown by Huo et al., [27] the doctor's experience is crucial, but it is strengthened by the experience of the hospital, which translates into the experience of the entire team. This justifies centralization, not only in terms of the number of hospitals, but also of the surgeons who carry out the most complex treatments within them [28]. In Poland, such a solution is used for robotic treatments.

The analysis of quantitative data indicates that to effectively achieve the goal of consolidating radical oncological surgery procedures, it is necessary to strengthen the mechanisms used or tweak them. A possible direction is to implement more rigid regulations specifying hospitals authorized to perform these procedures or specifying a minimum threshold for the volume of services below which the most complex procedures will not be financed by the payer.

The presented data also provoke consideration of a more thorough restructuring of the mechanism used. The incentives of provider payment systems are known to have an impact on the volume and quality of care. Research conducted by Link et al. [29] showed that the implementation of a minimum threshold for colon or rectal resections would exclude a lot of hospitals in the Netherlands that provide high quality treatment and include hospitals with lower-than-expected quality.

The number of procedures is an imperfect parameter of treatment quality. Surgical quality is influenced by case mix, surgical technique, diagnosis, process designs, organizational structures and volume. High volume has a positive impact on several of those factors, but only to some extent leads to quality improvement. Some authors write about a quality plateau [30] or a surrogate parameter that should be supplemented with other quality measurements – structural, process and result [29, 31, 32]. In Poland, such an opportunity is provided by regulations on the oncology network and the adopted Quality Act, which supports the implementation of quality parameters in the system and relates them to the level of hospital revenue.

A limitation of the study is that it does not account for the impact of the COVID-19 pandemic, which could have influenced the number of procedures conducted in hospitals. Although all hospitals operated under challenging conditions during the pandemic, the degree to which individual facilities were affected varied significantly. Additionally, the authors analyzed the values documenting the changes but have not further analyzed the causes of this situation. A further area that could be explored is the influence of other factors on the use of health services, and the subsequent volume of provision in a given hospital. These factors could include political or social factors, for example. Further qualitative research is needed.

Conclusions

The financial model introduced for radical oncology surgery was aimed to induce centralization of services. It is based on the additional revenue for high-volume hospitals with additional requirements regarding the treatment process. Its desired impact was insignificant, as the share of services performed in high-volume hospitals increased in a very slow peace and at the same time there were new providers entering the market with low number of surgical procedures.

Article information and declarations

Data availability statement

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Authors contributions

Monika Raulinajtys-Grzybek – conceptualization, writing – original draft preparation, writing – review and editing.
Barbara Więckowska – conceptualization, data curation, writing – original draft preparation, writing – review and editing.

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Conflict of interest

None declared

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References

1. Hannan EL, O'Donnell JF, Kilburn H, et al. Investigation of the relationship between volume and mortality for surgical procedures performed in New York State hospitals. JAMA. 1989; 262(4): 503–510, indexed in Pubmed: 2491412.
2. Harmon JW, Tang DG, Gordon TA, et al. Hospital volume can serve as a surrogate for surgeon volume for achieving excellent outcomes in colorectal resection. Ann Surg. 1999; 230(3): 404–11; discussion 411, doi: 10.1097/00000658-199909000-00013, indexed in Pubmed: 10493487.

3. Lazarides AL, Kerr DL, Nussbaum DP, et al. Soft Tissue Sarcoma of the Extremities: What Is the Value of Treating at High-volume Centers? Clin Orthop Relat Res. 2019; 477(4): 718–727, doi: 10.1097/01.blo.0000533623.60399.1b, indexed in Pubmed: 30485258.
4. Damle RN, Macomber CW, Flahive JM, et al. Surgeon volume and elective resection for colon cancer: an analysis of outcomes and use of laparoscopy. J Am Coll Surg. 2014; 218(6): 1223–1230, doi: 10.1016/j.jamcollsurg.2014.01.057, indexed in Pubmed: 24768291.
5. Drolet S, MacLean AR, Myers RP, et al. Elective resection of colon cancer by high-volume surgeons is associated with decreased morbidity and mortality. J Gastrointest Surg. 2011; 15(4): 541–550, doi: 10.1007/s11605-011-1433-x, indexed in Pubmed: 21279550.
6. Bennett CL, Stryker SJ, Ferreira MR, et al. The learning curve for laparoscopic colorectal surgery. Preliminary results from a prospective analysis of 1194 laparoscopic-assisted colectomies. Arch Surg. 1997; 132(1): 41–4; discussion 45, doi: 10.1001/archsurg.1997.01430250043009, indexed in Pubmed: 9006551.
7. Pucciarelli S, Zorzi M, Gennaro N, et al. Relationship between hospital volume and short-term outcomes: a nationwide population-based study including 75,280 rectal cancer surgical procedures. Oncotarget. 2018; 9(24): 17149–17159, doi: 10.18632/oncotarget.24699, indexed in Pubmed: 29682212.
8. Baek JH, Alrubaie A, Guzman EA, et al. The association of hospital volume with rectal cancer surgery outcomes. Int J Colorectal Dis. 2013; 28(2): 191–196, doi: 10.1007/s00384-012-1536-1, indexed in Pubmed: 22842664.
9. Więckowska B, Czerwiński A. Mierniki ilościowe w ocenie świadczeń zdrowotnych w Polsce – przykłady w onkologii i kardiologii. In: Więckowska B. ed. Świadczenia onkologiczne i kardiologiczne w Polsce – podejście ilościowe do oceny jakości leczenia i szacowania potrzeb. Ministerstwo Zdrowia, Warszawa 2015: 115–146.
10. Mahmoudi E, Lu Y, Chang SC, et al. Associations of Surgeon and Hospital Volumes with Outcome for Free Tissue Transfer by Using the National Taiwan Population Health Care Data from 2001 to 2012. Plast Reconstr Surg. 2017; 140(3): 455e–465e, doi: 10.1097/PRS.0000000000003593, indexed in Pubmed: 28841623.
11. Subramanian MP, Yang Z, Chang SH, et al. Minimum Volume Standards for Surgical Care of Early-Stage Lung Cancer: A Cost-Effectiveness Analysis. Ann Thorac Surg. 2022; 114(6): 2001–2007, doi: 10.1016/j.athoracsur.2022.06.017, indexed in Pubmed: 35780816.
12. Abarca T, Gao Y, Monga V, et al. Improved survival for extremity soft tissue sarcoma treated in high-volume facilities. J Surg Oncol. 2018; 117(7): 1479–1486, doi: 10.1002/jso.25052, indexed in Pubmed: 29633281.
13. Hallet J, Look Hong NJ, Zuk V, et al. Economic impacts of care by high--volume providers for non-curative esophagogastric cancer: a population-based analysis. Gastric Cancer. 2020; 23(3): 373–381, doi: 10.1007/s10120-019-01031-w, indexed in Pubmed: 31834527.
14. Nasseri Y, Stettler I, Shen W, et al. Learning curve in robotic colorectal surgery. J Robot Surg. 2021; 15(3): 489–495, doi: 10.1007/s11701-020-01131-1, indexed in Pubmed: 32754791.
15. Short MN, Aloia TA, Ho V. The influence of complications on the costs of complex cancer surgery. Cancer. 2014; 120(7): 1035–1041, doi: 10.1002/cncr.28527, indexed in Pubmed: 24382697.
16. Tustumi F, Portilho AS, Teivelis MP, et al. The impact of the institutional abdominoperineal resections volume on short-term outcomes and expenses: a nationwide study. Tech Coloproctol. 2023; 27(8): 647–653, doi: 10.1007/s10151-022-02733-7, indexed in Pubmed: 36454374.
17. Epstein AM. Volume and outcome--it is time to move ahead. N Engl J Med. 2002; 346(15): 1161–1164, doi: 10.1056/NEJM200204113461512, indexed in Pubmed: 11948278.
18. Więckowska B, Tolarczyk A. Innowacje w organizacji i finansowaniu leczenia – znaczenie pakietu onkologicznego. In: Więckowska B, Maciejczyk A. ed. Innowacyjna onkologia : potrzeby, możliwości, system. Wydawnictwo Lekarskie PZWL 2020: 1–339.
19. Art. 4a ust 1 rozporządzenia Ministra Zdrowia z dnia 22 listopada 2013 w sprawie świadczeń gwarantowanych w zakresie leczenia szpitalnego.
20. Sowada C, Sagan A, Kowalska-Bobko I, et al. Poland health system review. Health Syst Transit. 2011; 13(8): 1–193, indexed in Pubmed: 22551527.
21. Ihse I. The volume-outcome relationship in cancer surgery: a hard sell. Ann Surg. 2003; 238(6): 777–781, doi: 10.1097/01.sla.0000098616.19622.af, indexed in Pubmed: 14631214.
22. Vogel JFA, Barkhausen M, Pross CM, et al. Defining minimum volume thresholds to increase quality of care: a new patient-oriented approach using mixed integer programming. Eur J Health Econ. 2022; 23(7): 1085–1104, doi: 10.1007/s10198-021-01406-w, indexed in Pubmed: 35089456.
23. Gordon TA, Bowman HM, Tielsch JM, et al. Statewide regionalization of pancreaticoduodenectomy and its effect on in-hospital mortality. Ann Surg. 1998; 228(1): 71–78, doi: 10.1097/00000658-199807000-00011, indexed in Pubmed: 9671069.
24. Listorti E, Pastore E, Alfieri A. How to direct patients to high-volume hospitals: exploring the influencing drivers. BMC Health Serv Res. 2023; 23(1): 1269, doi: 10.1186/s12913-023-10229-9, indexed in Pubmed: 37974191.
25. Ciesielski M, Kruszewski W, Walczak J, et al. Surgical department profile focused on surgical oncology improves significantly the outcomes of major surgery for gastric cancer. Nowotwory. Journal of Oncology. 2016; 66(4): 293–298, doi: 10.5603/njo.2016.0056.
26. Healhcare Needs Maps, Baza Analiz Systemowych i Wdrożeniowych. https://basiw.mz.gov.pl/mapy-informacje/mapa-2022-2026/analizy/.
27. Huo YaR, Phan K, Morris DL, et al. Systematic review and a meta-analysis of hospital and surgeon volume/outcome relationships in colorectal cancer surgery. J Gastrointest Oncol. 2017; 8(3): 534–546, doi: 10.21037/jgo.2017.01.25, indexed in Pubmed: 28736640.
28. Chang CM, Yin WY, Wei CK, et al. The combined effects of hospital and surgeon volume on short-term survival after hepatic resection in a population-based study. PLoS One. 2014; 9(1): e86444, doi: 10.1371/journal.pone.0086444, indexed in Pubmed: 24466102.
29. Link KH, Coy P, Roitman M, et al. Minimum Volume Discussion in the Treatment of Colon and Rectal Cancer: A Review of the Current Status and Relevance of Surgeon and Hospital Volume regarding Result Quality and the Impact on Health Economics. Visc Med. 2017; 33(2): 140–147, doi: 10.1159/000456044, indexed in Pubmed: 28560230.
30. Kraus TW, Büchler MW, Herfarth C. Relationships between volume, efficiency, and quality in surgery--a delicate balance from managerial perspectives. World J Surg. 2005; 29(10): 1234–1240, doi: 10.1007/s00268-005-7988-5, indexed in Pubmed: 16136283.
31. Bagaria SP, Chang YH, Gray RJ, et al. Improving Long-Term Outcomes for Patients with Extra-Abdominal Soft Tissue Sarcoma Regionalization to High-Volume Centers, Improved Compliance with Guidelines or Both? Sarcoma. 2018; 2018: 8141056, doi: 10.1155/2018/8141056, indexed in Pubmed: 29849479.
32. Ho V, Short M, Aloia T. Can postoperative process of care utilization or complication rates explain the volume-cost relationship for cancer surgery? Surgery. 2017; 162(2): 418–428, doi: 10.1016/j.surg.2017.03.004, indexed in Pubmed: 28438333.