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ORIGINAL ARTICLE

Surgical trends of groin hernia repairs performed for recurrence in medicare patients

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Abstract

Background The recurrence rate after groin hernia repair (GHR) has been estimated to be between 1–10% in adult patients. Neither national rates nor trends in recurrence over time have been reliably established for Medicare patients in the USA.

Materials We evaluated patients undergoing GHR (inguinal = IHR; femoral = FHR) from 2011 to 2014 from the Medicare Provider Analysis and Review database. Patients were identified using ICD-9 diagnosis and ICD-9 and CPT procedure codes, stratified both by primary vs. recurrent hernia repair and by sex. One-tailed Cochran–Armitage tests evaluated trends over time and a generalized estimating equation model estimated factors associated with recurrent IHR or FHR.

Results We identified 407,717 patients (87.0%, ≥ 65 years) who underwent an IHR and 11,578 (91.0%, ≥ 65 years) who underwent a FHR. The proportion of IHRs for recurrence decreased statistically from 14.3% in 2011 to 13.9% in 2014 ($p < 0.01$) in males and was increased, but not statistically so (7.0–7.4%) in females ($p = 0.08$). The proportion of FHRs for recurrence was decreased, but not statistically so (16.3–14.8%, $p = 0.29$) in males and increased in females (5.3–6.3%, $p = 0.02$). On multivariable analysis, males were more than twice as likely as females to undergo recurrent repair (IHR or FHR, both $p < 0.01$).

Conclusions Within the Medicare population, recurrence rates after groin hernia repairs were found to be higher than previously reported but have remained clinically stable over time. Establishing and reducing this rate is important for patient outcomes and expectations.

Keywords Inguinal hernia · Femoral hernia · Groin hernia · Recurrence · MedPAR

Introduction

Groin hernia repair (GHR) is one of the most common general surgery procedures, with over 800,000 repairs performed annually in the United States [1]. While hernia repair has evolved over the years both in terms of mesh vs. non-mesh repairs and open vs. laparoscopic techniques,[2] recurrence following hernia repair continues to be an important clinical outcome. Unlike several European countries, which have longitudinal databases that allow for extensive analysis of hernia surgery and risk factors of recurrence, the United States does not have an established database to follow groin hernia outcomes [3]. The aforementioned longitudinal databases, the Swedish Hernia Registrar and the Danish Hernia Database, estimate the recurrence rate following groin hernia repair to be between 1–15%, with the proportion of repairs for recurrence being between 11 and 17% [3–8].

While studies have shown that the risk of inguinal hernia increases with age, recurrence rates in the elderly have not been extensively evaluated. It is worth further investigation of recurrence within elderly patients in the United States, as the vast majority of the elderly are Medicare beneficiaries. With the net cost of Medicare in 2016 equaling $566,114,000 [9] optimizing outcomes and reducing reoperations in this patient population is clinically important and

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financially relevant. As GHRs are one of the most common operations performed, we therefore sought to better understand the current state of GHR in the United States Medicare population, by estimating the proportion of inguinal and femoral hernia repairs (FHR) performed for recurrence using Medicare data.

Methods

A retrospective study of patients ≥ 18 undergoing IHR or FHR from January 1, 2011 to December 31, 2014 was performed using the Medicare Provider Analysis and Review (MedPAR) database. In the United States, Medicare is a health insurance program for people over the age of 65, under the age of 65 meeting specific criteria of disability, and people of all ages with End-Stage Renal Disease [9]. The MedPAR database contains inpatient data on procedures, diagnoses, Diagnosis-Related Group (DRG), length of stay, beneficiary and Medicare payment amounts, and summarized revenue center charge amounts from Medicare patient discharges for those on traditional fee-for-service Medicare [9]. Patients who were enrolled in Medicare managed care programs are not represented in the MedPAR data. Patients were identified using International Classification of Disease-9th Revision (ICD-9) diagnoses (inguinal ICD-9: 550.00, 550.01, 550.02, 550.03, 550.10, 550.11, 550.12, 550.13, 550.90, 550.91, 550.92, 550.93; femoral ICD-9: 551.00, 551.01, 551.02, 552.00, 552.02, 552.03, 553.00, 553.01, 553.02, 553.03) and surgical procedure codes (inguinal ICD-9: 17.11, 17.12, 17.13, 17.21, 17.22, 17.23, 17.24, 53.00, 53.01, 53.02, 53.03, 53.04, 53.05, 53.10, 53.11, 53.12, 53.13, 53.14, 53.15, 53.16, 53.17; femoral ICD-9: 53.21, 53.29, 53.31, 53.39) or Current Procedural Terminology (CPT) codes (inguinal CPT: 49505, 49507, 49520, 49521, 49525, 49650, 49651, 49659; femoral CPT: 49550, 49553, 49555, 49557). To be included, patients were required to have a primary ICD-9 diagnosis of IHR or FHR and either (1) CPT for IHR/FHR or (2) DRG 350–352 and ICD-9 procedure for IHR/FHR.

Patient comorbidities of diabetes (ICD-9: 250.xx), chronic obstructive pulmonary disease (COPD; ICD-9: 490–496, 500–504, 506.4), and obesity (ICD-9: 278.00, 278.01, 278.02, V853, V854) were identified by ICD-9 diagnosis codes. Cases were classified as an emergent or elective repair based on the patient's hospital admission type. Pregnant patients (identified by ICD-9 codes: 640–649, 650–659, V22, V23 or V28) and those undergoing robotic repair (ICD-9 codes: 17.4x, CPT: S2900) were excluded from the study.

The incidence of primary (inguinal CPT: 49505, 49507, 49650; femoral CPT: 49550, 49553) and recurrent (inguinal CPT 49520, 49521, 49651; femoral CPT: 49555, 49557) hernia repairs were evaluated and stratified by sex. If an IHR or FHR CPT code did not indicate primary or recurrent hernia repair (inguinal CPT: 49649, 49525; femoral CPT: 49659), ICD-9 diagnoses were used to indicate primary (inguinal ICD-9: 550.00, 550.02, 550.10, 550.12, 550.90, 550.92; femoral ICD-9: 551.00, 551.02, 552.00, 552.02, 553.00, 553.02) or recurrent (inguinal ICD-9: 550.01, 550.03, 550.11, 550.13, 550.91, 550.93; femoral ICD-9: 551.01, 551.03, 552.01, 552.03, 553.01, 553.03) repair. ICD-9 diagnoses were also used to indicate bilateral (inguinal ICD-9: 550.00, 550.01, 550.10, 550.11, 550.90, 550.91; femoral ICD-9: 551.02, 551.03, 552.02, 552.03, 553.02, 553.03) or unilateral (inguinal ICD-9: 550.02, 550.03, 550.12, 550.13, 550.92, 550.93; femoral ICD-9: 551.00, 551.01, 552.00, 552.01, 553.00, 553.01) IHR or FHR. CPT codes were used to indicate open (49505, 49507, 49520, 49521, 49525) or laparoscopic (49650, 49651, 49659) surgical approach for inguinal hernia; distinction between laparoscopic and open repairs was not available for FHRs.

Chi square tests were used for univariate analyses comparing patient characteristics between initial and recurrent hernia repair groups. Generalized estimating equation (GEE) multivariable models were used to examine factors associated with undergoing an initial vs. a recurrent hernia repair. Statistically significant and clinically relevant variables from the univariate analysis were included in the multivariable analyses. The factors evaluated included year of operation, age at surgery, race, inpatient vs. outpatient admission, laparoscopic or open repair (IHR only), bilateral repair, and comorbidities (obesity, diabetes, COPD, and smoking). Since the study was based on hospital discharge, to account for the fact that multiple discharges might happen for one patient, GEE modeling was used to adjust for clustering. The analyses were performed independently for IHR and FHRs. Outcomes of the multivariable models were reported as odds ratio (OR) with associated 95% confidence intervals (CI). Trends of the proportion of IHR or FHR repair for recurrence, stratified by sex, were analyzed for a decrease over time using a one-tailed Cochran–Armitage test. Statistical significance was evaluated at $p < 0.05$. All statistical analyses were performed using SAS Version 9.4 (SAS Institute Inc., Cary, NC, USA). Our Institutional Review Board committee deemed this project exempt from review.

Results

Inguinal hernia recurrence

A total of 407,717 patients (88.2% male) underwent an IHR during the study period, 87.0% of whom were ≥ 65 years of age and 13.0% percent who were Medicare disabled and < 65. Patient characteristics are reported in Table 1. The

Table 1 Patient characteristics

Characteristics	Inguinal hernia						Femoral hernia					
	Total		Initial repair		Recurrent repair		Total		Initial repair		Recurrent repair	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Age group												
< 65	53,141	13.0	46,625	13.2	6516	12.1	993	8.6	908	8.6	85	9.0
65–69	94,595	23.2	83,026	23.5	11,569	21.4	1831	15.8	1681	15.8	150	15.9
70–74	87,387	21.4	76,213	21.5	11,174	20.7	2029	17.6	1864	17.6	165	17.5
75–89	75,391	18.5	65,146	18.4	10,245	19.0	2120	18.3	1952	18.4	168	17.8
80–84	57,314	14.1	49,056	13.9	8258	15.3	2177	18.8	1988	18.7	189	20.0
> 84	39,403	9.7	33,266	9.4	6137	11.4	2410	20.8	2223	20.9	187	19.8
Unknown	486	0.1	439	0.1	47	0.1	–	–	–	–	–	–
Sex												
Male	359,842	88.3	309,337	87.4	50,505	93.6	2752	23.8	2330	21.9	422	44.7
Female	47,392	11.6	43,999	12.4	3393	6.3	8808	76.2	8286	78.1	522	55.3
Unknown	481	0.1	435	0.1	46	0.1	–	–	–	–	–	–
Race												
White	360,809	88.5	311,563	88.1	49,246	91.3	10,706	92.3	9786	92.2	920	94.1
Black	25,604	6.3	23,259	6.6	2345	4.3	–	–	–	–	–	–
Other	5187	1.3	4630	1.3	557	1.0	888	7.7	830	7.8	58	5.9
Asian	4580	1.1	4158	1.2	422	0.8	–	–	–	–	–	–
Hispanic	6532	1.6	5769	1.6	763	1.4	–	–	–	–	–	–
North American native	1033	0.3	913	0.2	120	0.2	–	–	–	–	–	–
Unknown	3479	0.9	3479	1.0	0	0	–	–	–	–	–	–
Obesity												
Yes	17,960	4.4	15,597	4.4	2363	4.4	286	2.5	286	2.5	NA	NA
No	389,755	95.6	338,174	95.6	51,581	95.6	11,274	97.5	11,274	97.5	NA	NA
Diabetes												
Yes	71,605	17.5	62,413	17.6	9192	17.1	1266	11.0	1154	10.9	112	11.9
No	336,110	82.4	291,358	82.4	44,752	82.9	10,294	89.0	9462	89.1	832	88.1
COPD												
Yes	79,752	19.6	68,284	19.3	11,468	21.2	3613	31.3	3274	30.8	339	35.9
No	327,963	80.4	285,487	80.7	42,476	78.8	7947	68.7	7342	69.2	605	64.1
Smoking status												
Yes	49,095	12.0	42,672	12.1	6423	11.9	1752	15.2	1591	15.0	161	17.1
No	358,620	88.0	311,099	87.9	47,521	88.1	9808	84.8	9025	85.0	783	82.9
Admission status												
Inpatient	32,794	8.0	26,741	7.6	6053	11.2	5138	44.4	4820	45.4	318	33.7
Outpatient	374,921	92.0	327,030	92.4	47,891	88.8	6422	55.6	5796	54.6	626	66.3
Bilateral repair												
No	353,354	86.7	306,814	86.7	46,540	86.3	10,453	98.5	10,453	98.5	NA	NA
Yes	54,361	13.3	46,957	13.3	7404	13.7	163	1.5	163	1.5	NA	NA

NA too small to be analyzed, – not analyzed

proportion of IHRs for recurrence decreased from 14.3% in 2011 to 13.9% in 2014 ($p < 0.01$) in males and remained constant from 7.0 to 7.4% in females ($p = 0.08$) as shown in Fig. 1.

On multivariable analysis, as age increased over 70 years, the risk of undergoing repair for recurrence increased as well (vs. < 65, all $p < 0.01$, Table 2). Male sex, inpatient admission, laparoscopic repair, and COPD were also statistically significantly associated with increased likelihood of undergoing a recurrent repair. Factors associated with decreased likelihood of undergoing a recurrent

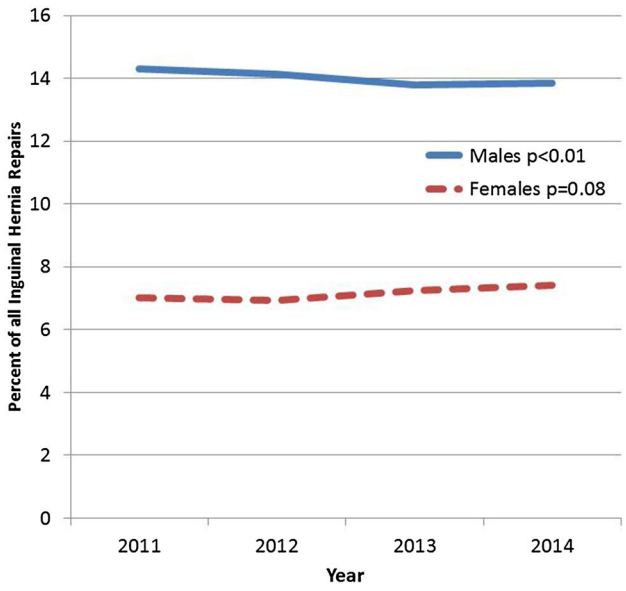

Fig. 1 Proportion of inguinal hernia repairs performed for recurrence stratified by sex

repair included more recent year of operation, race other than White, diabetes, and bilateral repair (Table 2).

Femoral hernia recurrence

A total of 11,578 (23.8% male) patients underwent a FHR during the study period, 91.0% of whom were ≥ 65 years of age and 9.0% percent who were Medicare disabled and < 65. Patient characteristics are reported in Table 1. The proportion of FHRs for recurrence remained relatively constant from 16.3% in 2011 to 14.8% in 2014 ($p = 0.29$) in males and increased from 5.3 to 6.3% in females ($p = 0.02$), Fig. 2.

On multivariable analysis, male sex and COPD were significantly associated with increased likelihood of undergoing a recurrent repair. Factors associated with decreased likelihood of undergoing a recurrent repair included inpatient admission (Table 2). Age was not associated with undergoing repair for a recurrent hernia in this patient population.

Discussion

In Medicare beneficiaries, hernia repairs for recurrence were substantial at approximately 14–15% of all repairs in males and 6–7% in females, and relatively stable over time. The proportion of IHRs for recurrence decreased in males and remained constant in females over our study period, while FHRs remained constant in males and increased in females. Even though some of the trends were statistically significant, all fluctuations were within ± 1.5% of the starting percentage, which lacks clinical significance. Our observed rates of recurrence are on par with international large database studies but are substantially higher than dozens of studies from the United States.

Hernia recurrence studies are more common in countries other than the United States, where large national hernia databases exist. These studies estimate the rate of recurrence after IHRs to be between 1–15% and between 0–6% after FHRs [3–8]. In terms of the proportion of repairs performed for recurrence, studies from the Swedish Hernia Registrar have ranged from 15–17% for GHRs and 21–26% for FHRs from the International Hernia Mesh Registry and the Shouldice hospital [7, 10, 11]. In contrast, within the United States, the majority of published studies is from single academic centers. These studies report the recurrence rate in adult patients to be between 0–10% for IHRs and < 1% for FHRs, and the proportion of repairs for recurrence to be between 11–31% for GHRs [12–20]. Follow-up, when reported, was relatively short and ranged from 6 months to 6 years, and occurred in at most 80% of patients [15]. Of note, an important issue with single center studies monitoring recurrence is that patients who suffer a hernia recurrence may choose to go to another institution for recurrent repair, perhaps an academic medical center or designated hernia repair center, skewing the proportions at these centers [21]. A previous study from our group evaluated the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database and the Premier database and found different findings to the current study results. In the NSQIP database, the proportion of FHRs performed for recurrence in females decreased from 14.0% in 2005 to 6.2% in 2014, $p = 0.02$, whereas this current study found the rate to increase in females from 5.3 to 6.3% in 2014. Despite the variance in trends in these studies, the rate was consistently approximately 6% in 2014. This discrepancy is likely related to the availability of data represented in large databases. In males, this prior study showed no change over the study period: 16.7–16.1%, 2005–2014 ($p = 0.18$), which is consistent with our current findings from the MedPAR database. In the Premier database, there was no difference for either gender over time in proportion of FHRs performed for recurrence, all $p > 0.05$ [22].

In our analysis, we found many factors associated with an increased or decreased likelihood of undergoing a recurrent hernia repair. For patients undergoing IHR, some of these factors associated with an increased likelihood included inpatient admission and laparoscopic repair. It is important to note that these results must be carefully interpreted, as an increased likelihood of undergoing a recurrent repair does not necessarily mean that recurrence is higher in all of these patient populations, or decreased in populations with a decreased likelihood. For example, our findings support that patents that underwent a recurrent repair were more likely to have the repair performed in a laparoscopic fashion,

Table 2 Multivariable analysis of factors associated with inguinal and femoral hernia repairs performed for recurrence

Effect	Inguinal hernia repair				Femoral hernia repair			
	ORs	95% Confidence interval		*p* value	ORs	95% Confidence interval		*p* value
Diagnosis year								
2012 vs. 2011	0.99	0.96	1.01	0.28	0.92	0.76	1.12	0.39
2013 vs. 2011	0.96	0.94	0.99	0.00	1.16	0.96	1.40	0.12
2014 vs. 2011	0.96	0.94	0.99	0.01	1.05	0.86	1.27	0.64
Sex								
Male vs. female	2.33	2.24	2.42	< 0.01	2.80	2.44	3.22	< 0.01
Age								
65–69 vs. < 65	0.98	0.95	1.02	0.28	1.09	0.81	1.47	0.56
70–74 vs. < 65	1.05	1.01	1.08	0.01	1.09	0.82	1.46	0.55
75–79 vs. < 65	1.14	1.10	1.18	< 0.01	1.12	0.83	1.50	0.47
80–84 vs. < 65	1.23	1.19	1.28	< 0.01	1.28	0.96	1.72	0.10
> 84 vs. < 65	1.35	1.30	1.41	< 0.01	1.27	0.94	1.72	0.12
Unknown vs. < 65	1.44	0.14	15.02	0.76	0.76	0.56	1.02	0.06
Race								
Asian vs. white	0.61	0.55	0.68	< 0.01	–	–	–	–
Black vs. white	0.64	0.61	0.67	< 0.01	–	–	–	–
Hispanic vs. white	0.85	0.79	0.92	< 0.01	–	–	–	–
North American native vs. white	0.84	0.69	1.02	0.08	–	–	–	–
Other vs. white	0.76	0.69	0.83	< 0.01	–	–	–	–
Unknown vs. white	0.96	0.87	1.07	0.47	–	–	–	–
Inpatient admission								
Yes vs. no	1.66	1.61	1.71	< 0.01	0.61	0.53	0.71	< 0.01
Laparoscopic								
Yes vs. no	1.48	1.45	1.52	< 0.01	–	–	–	–
Obese								
Yes vs. no	1.03	0.99	1.08	0.16	1.26	0.84	1.89	0.26
Diabetes								
Yes vs. no	0.93	0.91	0.96	< 0.01	1.02	0.83	1.26	0.83
COPD								
Yes vs. no	1.13	1.10	1.15	< 0.01	1.22	1.05	1.42	0.01
Smoking								
Yes vs. no	1.00	0.97	1.03	0.97	1.01	0.83	1.24	0.92
Bilateral								
Yes vs. no	0.89	0.86	0.92	< 0.01	0.62	0.31	1.23	0.17

and should not be interpreted as patients who underwent laparoscopic repair being more likely to suffer a recurrence. Additionally, in IHRs, patients who underwent a recurrent repair were more likely to be admitted to the hospital, as opposed to an interpretation of patients who were admitted to the hospital being more likely to suffer a recurrence.

We attempted to address the issues of sample size and follow-up using a large national database following Medicare patients. Another study that evaluated a large statewide database not limited to Medicare beneficiaries assessed over 58,000 IHRs in the AHRQ State Ambulatory Surgery Database from 2002 to 2003 and found that 10.9% of IHRs were for performed for recurrence, although they did not report sex-specific rates [20]. Due to known differences in hernia incidence between males and females, we chose to stratify our analysis by sex [3, 23]; when not stratified, the proportion of hernia repairs performed for recurrence was approximately 13% (data not shown). This suggests that while the rate remained relatively constant throughout our study period, it may be higher now than in years past—surprising, as we hypothesized that the rate would likely decrease as laparoscopic repairs became more common and surgeons become more accustomed to this technique of repair throughout recent years [4, 20, 24, 25]. Recent

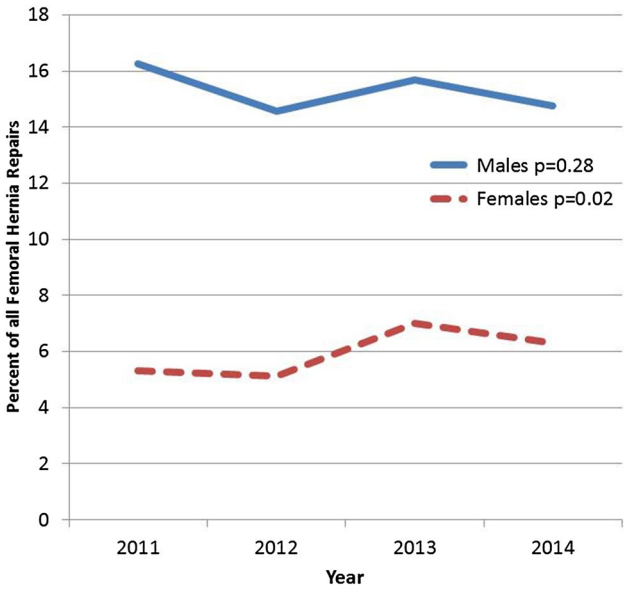

Fig. 2 Proportion of femoral hernia repairs performed for recurrence stratified by sex

studies focused on laparoscopic repairs report recurrence rates between 2–8%, which are higher than other reports of open repairs; therefore, perhaps we could have anticipated this lack of clinically significant decline in operations for recurrence.

Our study population was composed of elderly and disabled fee-for-service Medicare patients. Previous studies have shown that the risk of inguinal hernia development and recurrence increases with age, and is greater in males than females [3, 26]. Our data confirms that the risk of undergoing repair for recurrence of an IHR increases with age, and is indeed greater for males than females. While elective IHR is safe in the elderly, elderly patients have a greater rate of complications, longer length of stay, readmission, and higher risk of mortality [27–29].

Our study has several limitations. We used the proportion of hernia repairs performed for recurrence as a surrogate for the true recurrence rate. One issue with this is that not all patients who suffer a recurrence will undergo a reoperation. These patients may be more, or less, likely to undergo surgical repair than patients with a primary hernia. Using the reoperation rate as a surrogate for the true recurrence rate has been shown to underestimate the true recurrence rate by up to 40% [30]. Additionally, our study was not able to distinguish first time recurrent hernia repairs from multiple recurrent hernia repairs in the same patient, or the type of previous repair (open, laparoscopic, mesh, non-mesh repair). It is well known that the risk of recurrence increases with each recurrent repair [5]. This must be kept in mind when interpreting the results of our study. Also, we were unable to distinguish between primary and mesh based repairs. Finally, as with all retrospective studies based on billing data, our data are subject to coding errors. Despite these limitations, our study is composed of a large heterogeneous composition of patients and varied and diverse treatment centers which should have lower selection bias as compared to single-institution academic medical center and designated hernia center reports and is a better representation of the current state of hernia repairs in a United States Medicare patient population.

Conclusion

The proportion of IHRs and FHRs performed for recurrence in the United States in fee-for-service Medicare beneficiaries has remained clinically stable over time, but the rate is likely higher than previously reported, in both males and females—between 14–15% for males and 6–7% for females. Establishing and optimizing this rate is important for patient outcomes and expectations.

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Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to disclose. Dr. Zhang is an employee of Medtronic and completed the analysis of the MedPAR database. We teamed with Medtronic to help perform the statistical analyses of the MedPAR database due to their expertise in analyzing this extensive data source. Medtronic shared in our goals of identifying the current state of hernia repairs in the United States as a whole and offered to partner with us for this study. Dr. Zhang performed the statistical analysis of the MedPAR data, which was critically evaluated and discussed among all authors. All authors were involved in data interpretation. Our agreement with Medtronic precluded financial considerations for this project.

Ethical approval This study was reviewed by the Mayo Clinic IRB and found to be exempt as it involved de-identified data from national databases and they determined that it does not constitute research involving human subjects as defined under 45 CFR 46.102.

Human and animal rights This article does not contain any studies directly involving human participants, as it is a review of data already collected in a database.

Informed consent For this type of study, formal consent was not necessary.

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