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ORIGINAL RESEARCH

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Buddy operating in gynaecological oncology surgery: a large UK cancer centre's experience

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Abstract

Expert second opinions in surgery improve patient outcomes and influence surgical decision-making, allowing for peer review in peri-operative planning. The aim of this study is to assess the impact of "buddy operating" within gynaecological oncology on blood loss and length of stay (LOS) in hospital. A retrospective cohort study including all patients undergoing a hysterectomy (open and laparoscopic), for a gynaecological cancer, in 2004, 2014 and 2017. Data was collected using the hospital surgical ledger, Northern Ireland Electronic Care Record (NIECR) and online laboratory results. Data collected included the procedure performed, LOS, haemoglobin (Hb) levels pre- and post-operatively as a measure of blood loss, and number of consultants present. Only those for which insufficient data were available were excluded. Data was collected using Microsoft Excel and statistical analysis performed using JASPv0.16.1. The data followed a non-Gaussian distribution (Shapiro-Wilk $p < 0.001$). Analysis of Variance (ANOVA) was used to compare the frequency of procedures and overall Hb drop, The Wilcoxon-test was used to compare the mean Hb drop, and the Kruskal-Wallace test was used to compare the mean LOS. Statistical significance was defined as a p-value < 0.05. 630 patients were included. A 41.4% categorical reduction was shown in post-operative Hb drop between 2004 (22.7 g/L) and 2017 (13.3 g/L ($p = 0.015$)) for laparoscopic procedures following the implementation of buddy operating. There was no significant difference seen in the post-operative Hb drop for open procedures ($p = 0.069$). There was a 56% reduction in mean LOS from 2004 (12.1 days) to 2014 (6.1 days), which was significant for laparoscopic ($p = 0.0025$) and open procedures ($p = 0.000033$). In conlcusion, buddy operating is associated with a statistically significant reduction in blood loss for laparoscopic procedures and LOS for open and laparoscopic procedures.

Keywords

Buddy operating; Laparoscopy; Laparotomy; Hysterectomy

1. Introduction

Minimal access surgery (MAS) in gynaecological oncology has developed exponentially in the last three decades [1]. Initially, its purpose was diagnostic; however, following numerous studies demonstrating its less invasive and safer nature, laparoscopic surgeries have been adopted for major procedures performed in oncological surgery [2–4]. Within gynaecological oncology, laparoscopic surgery has been shown to provide a more superior intraoperative visualisation, smaller incisions, reduced blood loss, decreased post-operative complications, reduced length of hospital stay and a faster recovery [5, 6]. The first laparoscopic hysterectomy was performed by Reich *et al.* [7] in 1989 and developments have persisted since; for example, the first series describing outcomes from laparoscopic pelvic lymphadenectomy was published soon after in 1991 [8] and a laparoscopic approach to cytoreductive surgery for ovarian cancer was first described by Querleu and Leblanc in 1994 [9]. Laparoscopic approaches to major gynaecological surgeries, even in complex groups of patients [10], are now commonplace across specialist centres, with the proportion of cases performed laparoscopically likely to grow even further [11]. The use of robotic assisted MAS is also growing rapidly within gynaecological oncology, with a 68% increase in robotic MAS seen between 2007 and 2012 [1]. This is likely due to the opportunity for three-dimensional (3D) viewing to open endless opportunities [12–14], including increased depth perception, reduction in surgeon tremor, finer precision, shorter learning curve, and improved ergonomics for the operator [12, 14]. The demand on the surgical team has also evolved, with increased skill necessary for these more demanding and technically intricate procedures. To ensure the best surgical technique is employed in laparoscopic surgery, oncological principles and thorough knowledge of

pelvic anatomy must be achieved [15]. This is especially relevant with the incorporation of pelvic and para-aortic lymphadenectomy in oncological surgery [15, 16].

Evidence suggests that not all surgeons can achieve equivocal proficiency in laparoscopy [17] and that fellowship training in laparoscopic techniques improves patient outcomes [18, 19]. Furthermore, experience beyond the initial learning curve is required for proficiency and is associated with reduced intra-operative risk [18–20]. When acquiring surgical skills, additional dedicated laparoscopic operating time is needed to perform fine dissections and for correct 2-D orientation compared to open surgeries [19, 21]. Buddy operating has been shown to reduce the learning curve for technically difficult procedures, especially those which occur less often [22, 23]. This is true for radical hysterectomies, especially with a laparoscopic approach, following the results of the LACC trial [23–25] and a reduced cervical cancer incidence [23].

"Buddy operating" is a novel introduction to the surgical world and, by definition, involves two specialist surgeons operating together, allowing for the intra-operative combination of skills and the interaction between two specialists to enable shared decision making [26, 27], to reduce operating time [27–29]. Operating with another experienced surgeon has been shown to boost confidence, reduce the cognitive load and prevent fatigue during long procedures and therefore reduce perioperative risk [27, 30]. This is particularly beneficial in gynaecological oncology procedures, which tend to be long and technically complicated. There is some preliminary evidence to suggest that dual consultant operating in complex plastic, orthopaedic, spinal and arthroscopic surgery improves outcomes [28, 31, 32], with a 30% reduction in operating time, improved operative efficiency, and a reduction in length of stay (LOS) and peri-operative complications [28, 29]. This reduction in operating time, as a result of buddy operating, improves the patient's endocrine-metabolic response and therefore, improves their post-operative stress response and recovery [28, 33]. There is also evidence that dual-console operating for robotic surgery is at least not counterproductive, if not beneficial [34]. Dual consultant operating within colorectal cancer surgery has been shown to significantly reduce the conversion rate from laparoscopic to open with a subsequent improvement in long term survival [35]. Dual consultant operating is recommended by the Royal College of Surgeons in England [26] and was recommended by international surgical committees during the COVID-19 pandemic, with evidence that dual consultant operating was beneficial in long complicated procedures to reduce fatigue and dehydration, particularly for patients with COVID-19 [36].

Moreover, buddy operating has been shown to reduce learning curves following exposure to smaller numbers of complex cases, which occur less often [22, 27]. Expert second opinions in surgery have been shown to affect patient prognoses and outcomes, additionally influencing surgical decision-making [26–29]. Having two consultant specialists share a caseload allows for peer review in pre- and intra-operative planning; we hypothesise this will improve outcomes, especially in challenging cases where ambiguity and exact guidance may not exist.

The increased surgical complexity within gynaecological oncology prompted the gynaecological oncology consultant surgeons in the Northern Ireland Regional Cancer Centre (NIRCC) to implement changes in order to improve skills training and patient safety. This included the introduction of buddy operating as standard practice for all procedures, which ensures that two subspecialty trained gynaecological oncology consultant surgeons are present for all gynaecological oncology procedures. The gynaecological oncology department in the NIRCC subsequently performed a service evaluation of the "Buddy Operating" hypothesis with an initial case series of twelve patients undergoing laparoscopic radical trachelectomy, finding positive outcomes, similar to the aforementioned across other surgical disciplines, relating to operating time, blood loss and recovery [37].

Dual consultant, *i.e.*, "buddy operating", has not been explored fully within the difficult case mix of gynaecological oncology. Most evidence to date is limited to the learning curve of complex procedures only, specifically for cervical cancer [22, 23, 25, 37]. The aim of this study was to assess the impact of buddy operating on the gynaecological oncology service at a large UK tertiary cancer centre. Our study compared three separate years of data and aimed to demonstrate progression in the surgical techniques and procedures employed to manage gynaecological oncology patients.

2. Materials and methods

This retrospective cohort study examined all hysterectomies performed for gynaecological malignancies over three separate years in the Northern Ireland Regional Cancer Centre, Belfast Health and Social Care Trust (BHSCT). The years studied were 2004 (before buddy operating was introduced as standard practice), 2014 (following the implementation of regular buddy operating as standard practice) and 2017 (three years following the introduction of buddy operating when the service was well established) to get a spread of pre and post buddy system implementation whilst also assessing the changing operative practices over a prolonged period. Data were extracted from multiple sources including the hospital surgical ledger, Northern Ireland Electronic Care Record (NIECR) and online laboratory results (LabCentreLIVE).

Specific data-fields included the procedure performed (total abdominal hysterectomy (TAH), total laparoscopic hysterectomy (TLH), Radical abdominal hysterectomy (RAH), Laparoscopic radical hysterectomy (LRH), nodal dissection, and omentectomy), length of hospital stay (LOS), haemoglobin (Hb) levels pre and post operatively (as a measure of intraoperative blood loss), and the number of gynaecological oncology consultants present. These variables were chosen to assess the patient specific surgical outcomes related to the perioperative period for gynaecological oncology procedures. All patients undergoing a hysterectomy within the gynaecological oncology service in the given time frame were included. Only those for which insufficient data were available were excluded from the overall cohort.

Data was collected using Microsoft Excel (V17.78, Microsoft Corporation, Redmond, WA, USA) and statistical analysis performed using JASP v0.16.1. The data was found to follow a non-Gaussian distribution using the Shapiro-Wilk test

($p < 0.001$). ANOVA was used to compare the frequency of procedures and overall haemoglobin drop over the three years studied. The Wilcoxon test was used to compare the mean drop of Hb for buddy *vs.* non-buddy operating and the Kruskal Wallace test used to compare the mean LOS in hospital. Statistical significance was defined as a p-value < 0.05.

3. Results

A total of 695 patients were identified from the hospital surgical ledgers, which included all patients undergoing a hysterectomy following a diagnosis of gynaecological malignancy. Data was analysed for the 695 patients to compare the procedures and haemoglobin drop analysis. 65 patients were excluded due to insufficient data or having an unidentifiable hospital number giving an attrition rate of 9.3% and a final cohort of 630 patients. It is unlikely that attrition bias has been introduced as a result of this as there were no systematic differences between those who were included compared to those who were excluded due to administrative difficulties only.

All patients included in this review had a gynaecological malignancy for which they were treated by an open or laparoscopic hysterectomy and/or other indicated procedures. Buddy operating was demonstrated in 20%, 48% and 50% of hysterectomies performed in 2004, 2014 and 2017 respectively (Table 1). There is an increase in the number of "buddy" procedures from 2004 to 2017, especially in the laparoscopic cases, which have increased from 8 in 2004 to 72 in 2014 and 55 in 2017 (Table 1). The number of open "buddy" hysterectomies also increased from 38 in 2004 to 44 in 2014 and 60 in 2017 (Table 1). "Non-Buddy" Laparoscopic cases also increased across the studied years from 16 in 2004 to 60 in 2014 to 56 in 2017 (Table 1). In contrast, the numbers of open cases performed without another senior surgeon as a "buddy" decreased (154 cases in 2004, 71 in 2014 and 58 in 2017).

3.1 Intra-operative blood loss

Table 2 highlights the drop in Hb for all procedures, including buddy and non-buddy procedures, performed in the study timeframe. When comparing pre and post implementation of regular buddy operating we see a statistical difference in post-operative drop in Hb. Initially in 2004 there is no statistical significance in blood loss comparing buddy and non-buddy operations for TLH ($p = 0.34$), however, a statistically significant difference in Hb drop is seen in 2014 ($p = 0.0095$), following the implementation of buddy operating, as shown in Fig. 1.

As demonstrated, the difference in Hb drop (as a measure of intra-operative blood loss) in laparoscopic procedures was 22.7 g/L in 2004 and decreased to 15.1 g/L in 2014 ($p = 0.015$), with a further drop seen in 2017 to 13.3 g/L. In contrast, the Hb drop in open procedures has not changed significantly from 18.2 g/L in 2004, 18.15 g/L in 2014 to 17.8 g/L in 2017, resulting in a 2.2% reduction overall.

3.2 Length of hospital stay

There was an overall 56% reduction in mean LOS from 2004 (12.1 days) to 2014 (6.1 days), with a further modest decrease in LOS from 2014 to 2017 of 0.84 days. When looking at the individual procedures performed, separating laparoscopic and open procedures (Table 3), the trend in improvement of LOS is exhibited showing statistical significance across all three years studied (Fig. 2).

4. Discussion

4.1 Summary of main results

All patients included in this study underwent, as a minimum, a total hysterectomy (open or laparoscopic) for a gynaecological malignancy with a 30% increase in "buddy" procedures from 2004 to 2017, especially those performed laparoscopically. However, from 2014 to 2017 the buddy procedures performed laparoscopically (both hysterectomies and other) slightly decreased in number. This may be attributed to the changing management of gynaecological malignancies to more complex open procedures but would require more in-depth investigation.

There is a clear link between buddy operating and a reduced blood loss at laparoscopic surgery. The data shows a 41.4% categorical reduction in post-operative drop in Hb for laparoscopic procedures between 2004 and 2017 ($p = 0.015$), following the implementation of regular buddy operating. This is likely due to the shared decision making between two expert surgeons allowing for the combination of skill and expertise during more technically difficult procedures [26, 27]. There was, however, no significant difference seen in the post-operative drop in Hb for open procedures, with a 2.2% reduction from 2004 to 2017 ($p = 0.069$). This could be attributed to an increase in surgical complexity across the period studied or a change in the individual patient demographics over time, for example, increased body mass index (BMI). However, these individual patient demographics were not assessed as part of this study.

Length of stay (LOS) reduction is shown to be statistically significant across the procedures performed in this study with a 56% reduction in LOS between 2004 and 2014, following the implementation of buddy operating as standard practice. This shows more statistical significance for the laparoscopic group ($p = 0.000033$) when compared with the open group ($p = 0.0025$), but both remain statistically significant. This was significant for both the buddy and non-buddy cohorts so there may be other factors contributing to this improvement. Buddy operating has, however, been shown in previous studies to positively impact both LOS and blood loss [18, 27–29, 38]. There is an argument for an improvement in surgical technique following a period of buddy operating, with a shorter learning curve for more technically challenging procedures, or those which occur less often [22, 23, 25], which has potentially influenced the non-buddy procedures performed in subsequent years.

TABLE 1. Summary of procedures performed, number of gynaecological oncologists, and Hb drop over the three years analysed (2004, 2014 and 2017).

Procedure	Buddy			Non-Buddy			Overall			Total
	2004 (N = 38)	2014 (N = 115)	2017 (N = 99)	2004 (N = 150)	2014 (N = 127)	2017 (N = 101)	2004 (N = 188)	2014 (N = 242)	2017 (N = 200)	(N = 630)
Total Laparoscopic Hysterectomy (TLH)	1	49	36	8	54	49	9	103	85	197
Total Abdominal Hysterectomy (TAH)	23	42	51	125	69	51	148	111	102	343
Laparoscopic Radical Hysterectomy (LRH)	5	22	9	6	2	1	11	24	10	45
Open Radical Hysterectomy (ORH)	9	2	3	11	2	0	20	4	3	27
Additional Procedures	2004 (N = 26)	2014 (N = 79)	2017 (N = 58)	2004 (N = 91)	2014 (N = 46)	2017 (N = 27)	2004 (N = 116)	2014 (N = 125)	2017 (N = 85)	Total (N = 326)
Nodal Dissection	14	45	29	32	17	8	46	62	37	145
Omentectomy	11	34	29	59	29	19	70	63	48	181
	Number of gynae-oncology consultants present									
	2004			2014		2017		Overall		
Mean (SD*)	1.21 (0.44)			1.55 (0.63)		1.53 (0.56)		1.44 (12.20)		
Median (range)	1.00 (0, 3.00)			1.00 (1.00, 3.00)		1.00 (1.00, 3.00)		1.00 (0, 3.00)		
	Postoperative Haemoglobin (Hb) Drop									
	2004			2014		2017		Overall		
Mean (SD)	19.1 (16.70)			16.2 (8.52)		15.7 (10.60)		16.9 (12.20)		
Median (range)	19.0 (−50.00, 66.00)			15.0 (1.00, 52.00)		15.0 (−7.00, 58.00)		16.0 (−50.00, 66.00)		

**SD: Standard Deviation.*

TABLE 2. Comparison of drop in Hb for procedures performed in 2004, 2014, 2017 comparing buddy and non-buddy procedures.

Procedure	Buddy			Non-Buddy		
	2004	2014	2017	2004	2014	2017
TAH	(N = 23)	(N = 42)	(N = 51)	(N = 125)	(N = 69)	(N = 148)
Mean (SD*)	20.6 (13.4)	19.6 (10.2)	18.4 (11.9)	17.0 (17.1)	16.4 (9.11)	17.5 (16.6)
Median (range)	23.0 (−44.0, 44.0)	18.0 (4.0, 43.0)	16.0 (1.0, 58.0)	16.0 (−50.0, 66.0)	14.0 (4.0, 52.0)	17.0 (−50.0, 66.0)
TLH	(N = 1)	(N = 49)	(N = 36)	(N = 8)	(N = 54)	(N = 49)
Mean (SD)	19.0 (NA)	13.9 (8.2)	12.9 (8.3)	27.6 (17.2)	14.7 (6.2)	12.3 (8.3)
Median (range)	19.0 (19.0, 19.0)	13.0 (1.0, 35.0)	13.5 (−7.0, 36.0)	32.0 (−3.0, 47.9)	15.5 (2.0, 28.0)	10.0 (−1.0, 36.0)
LRH	(N = 5)	(N = 22)	(N = 9)	(N = 6)	(N = 2)	(N = 1)
Mean (SD)	19.0 (8.7)	17.0 (5.9)	18.7 (12.3)	27.0 (20.5)	17.5 (12.0)	20.0 (-)
Median (range)	24.0 (5.0, 26.0)	17.5 (7.0, 26.0)	15.0 (7.0, 48.0)	21.5 (9.0, 66.0)	17.5 (9.0, 26.0)	20.0 (20.0, 20.0)
Omentectomy	(N = 11)	(N = 34)	(N = 29)	(N = 59)	(N = 29)	(N = 19)
Mean (SD)	15.5 (16.2)	19.1 (11.0)	19.4 (11.2)	17.3 (18.4)	16.5 (6.8)	17.6 (12.1)
Median (range)	19.0 (−23.0, 33.0)	17.0 (3.0, 43.0)	18.0 (6.0, 49.0)	17.0 (−50.0, 53.0)	17.0 (4.0, 32.0)	16.0 (2.0, 48.0)
Nodal Dissection	(N = 14)	(N = 45)	(N = 29)	(N = 32)	(N = 17)	(N = 46)
Mean (SD)	22.5 (17.9)	16.8 (8.8)	18.7 (13.1)	24.3 (14.7)	14.1 (7.7)	20.1 (10.5)
Median (range)	213.5 (−23.0, 46.0)	17.0 (1.0, 43.0)	15.0 (−7.0, 66.0)	23.0 (−5.0, 66.0)	16.0 (3.0, 27.0)	21.5 (0, 32.0)

*TAH: Total Abdominal Hysterectomy; TLH: Total Laparoscopic Hysterectomy; LRH: Laparoscopic Radical Hysterectomy; * SD: Standard Deviation.*

Reade *et al.* [22] demonstrated that the learning curve for more technically challenging procedures, like a total laparoscopic radical hysterectomy (TLRH), was flattened when the buddy technique was employed. Their study also compared estimated blood loss (EBL) and LOS in addition to length of operative time and lymph node count, showing an improvement in all aspects. They also found non-significant changes in decreasing peri-operative complications and post-operative patient morbidity. This has subsequently been supported by Moufawad *et al.* [23] following the results of the LACC trial and the reduction in cervical cancer incidence [23, 24]. The findings of this study are in keeping with the limited evidence available in the literature with the overall trends showing a decrease in intra-operative blood loss both in open and laparoscopic procedures. The measurement of pre- and post-operative drop in Hb, to quantify intra-operative blood loss, however, is a more accurate objective assessment in comparison to the subjective EBL.

4.2 Strengths and weaknesses

To our knowledge, this is the first study to comprehensively assess the impact of buddy operating on patient outcomes associated with gynaecological oncology surgery. The strengths of this study include the large time frame included, therefore generating a large cohort of patients. All major gynaecological oncology procedures were included giving insight into the broad scope of gynaecological oncology, unlike other published literature which assessed individual procedures only, and tend to focus on the management of cervical cancer only [22, 23, 25, 27]. All patients with a gynaecological malignancy in Northern Ireland (NI) are discussed at a single regional gynaecological oncology multi-disciplinary team (MDT) meeting. This ensures high homogeneity and generalisability of the data, as it represents all patients within NI. Weaknesses include the retrospective nature of data collection, and no data was collected on patient demographics, operative time, complication rates or long term patient outcomes, including survival.

4.3 Implications for practice and future research

There is the potential to expand and investigate buddy operating and its positive influence on surgical outcomes further. Given this clear improvement in patient outcomes associated with gynaecological oncology surgery it would be useful to consider an analysis into the learning curves for surgical procedures, length of operative times, cytoreductive outcomes, peri-operative complications, and long term outcomes including survival, to see if this improvement translated to other aspects of the surgical journey. This will also give an opportunity to undertake a deeper analysis into the LOS for both open and laparoscopic procedures. An assessment of the use of buddy

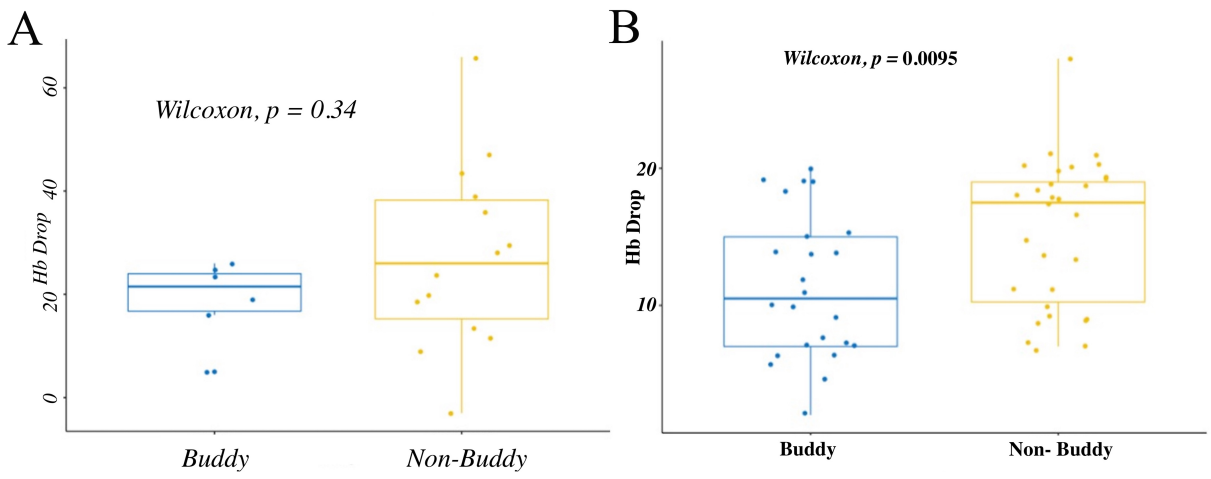

FIGURE 1. Comparison of Hb drop for buddy and non-buddy procedures in 2004 compared to 2014. (A) Comparison of Hb drop in 2004. (B) Comparison of Hb drop in 2014.

TABLE 3. Comparison of length of hospital stay for TAH and TLH (buddy *vs.* non-buddy) across all years studied.

Procedure	Buddy				Non-Buddy			
	2004	2014	2017	*p* Value	2004	2014	2017	*p* Value
TAH	(N = 23)	(N = 42)	(N = 51)		(N = 125)	(N = 69)	(N = 51)	
Mean (SD*)	14.1 (7.8)	10.2 (11.4)	9.46 (8.8)	2.5×10^{-3}	14.2 (9.1)	6.91 (4.3)	5.86 (3.7)	7.9×10^{-16}
Median (range)	12.0 (6.0, 35.0)	7.0 (2.0, 73.0)	7.0 (0, 59.0)		11.0 (1.0, 57.0)	6.0 (1.0, 24.0)	5.0 (1.0, 57.0)	
TLH	(N = 1)	(N = 49)	(N = 36)		(N = 8)	(N = 54)	(N = 49)	
Mean (SD)	16.0 (-)	4.2 (4.40)	2.4 (1.4)		6.0 (0)	4.0 (4.0)	2.5 (1.4)	
Median (range)	16.0 (16.0, 16.0)	3.0 (1.0, 29.0)	2.0 (0, 6.0)	3.3×10^{-5}	6.0 (6.0, 6.0)	3.0 (1.0, 28.0)	2.0 (1.0, 8.0)	7.7×10^{-8}

*TAH: Total Abdominal Hysterectomy; TLH: Total Laparoscopic Hysterectomy; *SD: Standard Deviation.*

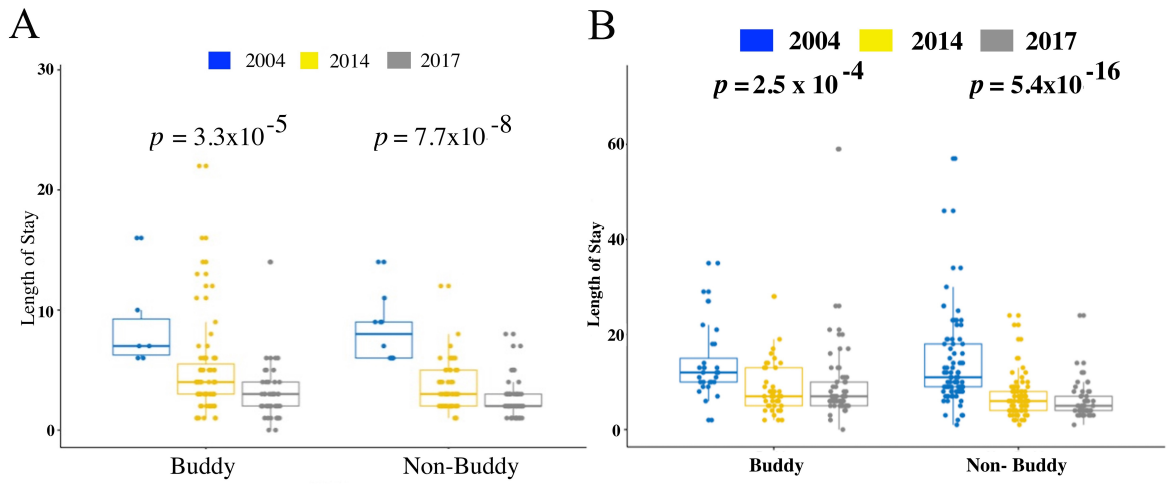

FIGURE 2. Length of hospital stay for procedures in 2004, 2014 and 2017. (A) Length of hospital stay for laparoscopic procedures. (B) Length of hospital stay for open procedures.

operating within the different gynaecological cancer sites may be of benefit in the future.

5. Conclusions

Buddy operating within gynaecological oncology surgery is associated with a significant reduction in intra-operative blood loss and LOS, most notably for laparoscopic procedures. A more in depth analysis is encouraged to further assess the impact of buddy operating on LOS in comparison to non-buddy procedures as well other aspects of the surgical journey.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

MMcC—designed the research study. JCM, KR, MMcL, LC, MMcC—performed the research; developed the manuscript. JCM and KR—analysed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The National Health Service (NHS) Health Research Authority decision tool was used. This study was defined as a service evaluation of the gynaecological oncology service within the BHSCT, following the implementation of buddy operating. Therefore, no NHS research ethics committee review was necessary.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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