

# Factors That Influence Length of Stay for In-Patient Gynaecology Surgery: Is The Case Mix Group (CMG) or Type of Procedure More Important?

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## Abstract

**Objectives:** To compare the association between the Case Mix Group (CMG) code and length of stay (LOS) with the association between the type of procedure and LOS in patients admitted for gynaecology surgery.

**Methods:** We examined the records of women admitted for surgery in CMG 579 (major uterine/adnexal procedure, no malignancy) or 577 (major surgery ovary/adnexa with malignancy) between April 1997 and March 1999. Factors thought to influence LOS included age, weight, American Society of Anesthesiologists (ASA) score, physician, day of the week on which surgery was performed, and procedure type. Procedures were divided into six categories, four for CMG 579 and two for CMG 577. Data were abstracted from the hospital information costing system (T2 system) and by retrospective chart review. Multivariable analysis was performed using linear regression with backwards elimination.

**Results:** There were 606 patients in CMG 579 and 101 patients in CMG 577, and the corresponding median LOS was four days (range 1–19) for CMG 579 and nine days (range 3–30) for CMG 577. Combined analysis of both CMGs 577 and 579 revealed the following factors as highly significant determinants of LOS: procedure, age, physician, and ASA score. Although confounded by procedure type, the CMG did not significantly account for differences in LOS in the model if procedure was considered. Pairwise comparisons of procedure categories were all found to be statistically significant, even when controlled for other important variables.

**Conclusion:** The type of procedure better accounts for differences in LOS by describing six statistically distinct procedure groups rather than the traditional two CMGs. It is reasonable therefore to consider changing the current CMG codes for gynaecology to a classification based on the type of procedure.

**Key Words:** Gynaecology surgery, length of stay, case mix groups

Competing Interests: None declared.

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## Résumé

**Objectifs :** Comparer l'association entre le code « groupe de maladies analogues » (GMA) et la durée de séjour (DDS) à l'association entre le type d'intervention et la DDS chez les patientes hospitalisées en raison d'une chirurgie gynécologique.

**Méthodes :** Nous nous sommes penchés sur les dossiers de femmes hospitalisées en raison d'une chirurgie de code GMA 579 (intervention utérine / annexielle majeure, aucune malignité) ou 577 (chirurgie majeure visant les ovaires / annexes, présence de malignité) entre avril 1997 et mars 1999. Parmi les facteurs soupçonnés d'influencer la DDS, on trouvait l'âge, le poids, le score ASA (*American Society of Anesthesiologists*), le médecin, le jour de la semaine au cours duquel la chirurgie a été effectuée et le type d'intervention. Les interventions étaient divisées en six catégories, quatre pour le GMA 579 et deux pour le GMA 577. Les données ont été extraites du système d'établissement du prix de revient de l'information hospitalière (système T2) et au moyen d'une analyse de dossiers rétrospective. Une analyse multivariable a été effectuée au moyen d'une régression linéaire par degrés éliminatoires.

**Résultats :** Nous comptons 606 patientes de code GMA 579 et 101 patientes de code GMA 577, et la DDS médiane correspondante était de quatre jours (plage 1–19) pour le GMA 579 et de neuf jours (plage 3–30) pour le GMA 577. L'analyse combinée des GMA 577 et 579 a révélé que les facteurs suivants s'avéraient des déterminants hautement significatifs de la DDS : intervention, âge, médecin et score ASA. Bien que confondu par le type d'intervention, le GMA n'a pu expliquer de façon significative les différences en matière de DDS dans le contexte du modèle, lorsque l'intervention était prise en considération. Les comparaisons par paire des catégories d'intervention se sont toutes avérées significatives sur le plan statistique, même à la suite de la neutralisation d'autres variables importantes.

**Conclusion :** Le type d'intervention parvient mieux à expliquer les différences en matière de DDS en décrivant six groupes d'intervention statistiquement distincts, plutôt que les deux GMA traditionnels. Ainsi, il est raisonnable d'envisager l'abandon des codes GMA actuels en ce qui concerne la gynécologie, au profit d'une classification fondée sur le type d'intervention.

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## INTRODUCTION

Managing the costs related to the provision of health care is of paramount importance. In the Canadian health care system, cost-effective care can improve access to required health care services and facilitate the introduction of new services and technologies. In order to help acute health care institutions manage their resources effectively, the Canadian Institute for Health Information (CIHI) developed methodologies designed to compare the costs of specific health care services from one hospital to another. In the 1980s, a classification for acute inpatient services was developed that consisted of Case Mix Groups (CMGs).<sup>1</sup> Patients were categorized in order to form clinically homogeneous groups (based on procedure or diagnosis), and/or groups were expected to have similar resource utilization. The original groupings were refined in 1997 in order to better reflect variations in length of stay (LOS) (or resource utilization) by adjusting for differences in age and other comorbid conditions.

The use of adjusted CMG codes is very important in the administration of health care in Canada.<sup>2</sup> CMGs are used to develop funding formulas for inpatient services based on the determination of Resource Intensity Weights (RIWs). RIWs are derived from a number of factors that affect resource utilization, such as rates of patient transfer, deaths, rates of unusually long patient stay, and proportions of typical cases. RIWs indicate the relative cost of treating patients classified into CMGs and are used to determine the funding government agencies provide for acute care services.

CMG figures are used to compare the performance of acute care institutions and their patient programs with one another. LOS benchmarks are used to calculate the number of potential hospital days that can be saved if a hospital program meets the established benchmark. This information has been used to plan hospital programs, to monitor clinical practice and resource utilization, and to establish LOS expectations for more efficient patient discharge planning. Individual physician variations in LOS have also been examined using CMG categories.

We have previously shown for CMG 579 (major uterine/adnexal surgery, no malignancy) that the type of procedure is an important determinant of LOS and therefore cost.<sup>3</sup> Other gynaecology publications clearly support these findings.<sup>4,5</sup> That procedure type affects both patient outcomes and resource utilization is further evident when different surgical approaches to hysterectomy are compared.<sup>6</sup> In the most recent (2005) Ontario Hospital Report, the ratio of abdominal to vaginal hysterectomies is now being used as an index of utilization.<sup>7</sup> Detailed information on both LOS and cost has been reported specifically for

abdominal hysterectomy in data from the Ontario Case Costing project.<sup>8</sup>

In populations of gynaecology patients, most utilization comparisons of LOS are based on CMG and RIW with little consideration given to the type of procedure. Interestingly, there is a remarkable diversity of procedure types included in the common CMG codes for gynaecology. Because physicians comprehend utilization statistics better if they are based on specific surgical procedures rather than a complex CMG code, there is a need to know whether using procedure type in gynaecology surgery as a means of comparing resource utilization and LOS for inpatient gynaecology units in Ontario hospitals is valid. The main purpose of this study was to determine whether the type of procedure or the CMG code is a better predictor of length of stay (and therefore resource utilization) in a cohort of women undergoing a gynaecology procedure.

## MATERIALS AND METHODS

We reviewed data from the practices of three gynaecology oncologists, two urogynaecologists, and nine general gynaecologists operating at London Health Sciences Centre (LHSC). LHSC is a teaching hospital that provides secondary and tertiary level gynaecology care and training for both undergraduate and postgraduate trainees.

All patients admitted to LHSC for gynaecology surgery between April 1997 and March 1999 were identified. Data from patients in CMG 579 and CMG 577 who had a primary surgical procedure performed by one of the gynaecologists at this centre were used for the analysis. CMG 579 is defined as major uterine and/or adnexal procedures without malignancy, and CMG 577 is defined as major gynaecologic procedures for malignancy, ovary or adnexa. Data were abstracted through the hospital information costing system (T-2 system) and retrospectively by chart review. Length of stay was used as the main outcome measure.

The T-2 costing system contains data obtained under the auspices of the Ontario Case Costing Initiative. This standardized case costing methodology is used within the province of Ontario to estimate hospital costs for medical services and procedures. When this work began in 2001–2002, case costing data were complete only until 1999. The costing methodology is outlined on the website of the Ontario Case Costing Initiative.<sup>9</sup> In addition to the costing data abstracted from the T-2 costing system, abstracted information was obtained retrospectively by chart review. This included some information on patient demographics, preoperative and postoperative diagnoses, weight on admission, American Society of Anesthesiologists (ASA) operative morbidity score, review and categorization of the

patient's operative procedure, surgeon, day of the week of surgery, and any postoperative complications or need for blood transfusions. Postoperative diagnosis was not included in the statistical analysis because CMG 577 is defined on this basis (adnexal malignancy) and all cases were diagnosed postoperatively as ovarian cancer. For the analysis, physicians were categorized into two groups: (1) gynaecology oncologists (3 physicians), and (2) gynaecologists (2 urogynaecologists and 9 general gynaecologists).

Six procedure categories were created for the analysis in order to stratify patients into meaningful groupings for the practising clinician. Procedures were divided into four categories for CMG 579 and into two categories for CMG 577. For CMG 579, the categories were as follows:

1. abdominal surgery (abdominal hysterectomy or adnexal surgery with or without surgery for urinary incontinence)
2. abdominal repair surgery (for prolapse or urinary incontinence, including retropubic urethropexy with or without sacrospinous vaginopexy)
3. vaginal surgery (vaginal hysterectomy or laparoscopic assisted vaginal hysterectomy, with or without anterior or posterior colporrhaphy or vaginal bladder repair)
4. laparoscopic surgery (laparoscopic adnexal procedures, and other miscellaneous gynaecology vaginal procedures such as fistula repair).

CMG 577 was divided into two categories: patients were classified as having either a debulking procedure for advanced ovarian carcinoma (Stage III or higher) or a staging procedure for early stage ovarian cancer. In most cases, staging procedures consisted of omentectomy, biopsies of peritoneal surfaces, and biopsies or removal of pelvic and/or para-aortic lymph nodes, in addition to hysterectomy and bilateral salpingo-oophorectomy.

Statistical analysis was performed using the *t* test for comparing means. Frequencies were compared using chi-square and Wilcoxon testing. Potential factors influencing LOS were first analyzed by univariable testing, and then significant factors were entered into a multivariable logistic regression model using backwards elimination. Entry and removal of factors was allowed at a significance level of 0.1. The Tukey test was used for pairwise comparisons of the procedure categories. These comparisons were adjusted for the other factors influencing LOS. Results were considered significant at a  $P < 0.05$ . Data were analyzed using SAS Version 8.02 (SAS Institute, Carey, NC).

## RESULTS

Data from 707 patients were included in the study; 606 patients were included in CMG 579 and 101 patients in CMG 577. Demographic data and procedural frequencies are shown in Table 1. The two patient populations for CMG 577 and 579 differed substantially in a number of respects. ASA scores were significantly higher in the CMG 577 population, and many more patients in CMG 577 underwent surgery during the latter part of the study. Patients were significantly older in CMG 577 (mean age 60.1 years compared with 45.1 years in CMG 579), and there were significantly more patients over the age of 60 (53.5% and 16% in CMG 577 and 579, respectively). The mean weight of patients in CMG 579 was significantly higher than in CMG 577 (71.3 kg vs. 66.4kg,  $P < 0.05$ ). The three oncologists were primarily responsible for performing most of the procedures in CMG 577 but performed few of the procedures in CMG 579.

The length of stay (LOS) according to procedure is shown in Table 2. Debulking procedures had the longest median LOS (12 days), whereas the laparoscopic surgery category had the shortest median LOS (1 day).

Complications were examined in patients with a LOS longer than one week. Complications were divided into major and minor groups; major complications were those that were responsible for prolonging LOS. As shown in Table 3, complications were relatively rare in CMG 579 but much more common in CMG 577. In CMG 579, there were six major and two minor complications in eight patients, whereas in CMG 577 there were 19 major and 17 minor complications in 28 patients. Of the 36 total complications in CMG 577, there were 28 complications (16 major and 12 minor) in patients undergoing debulking surgery, and there were only six complications (2 major and 4 minor) in patients having staging procedures. Two complications (1 major and 1 minor) were in patients with unknown surgical procedures. Some patients experienced more than one complication. Nine patients (1.5%) in CMG 579 had a LOS longer than one week with no documented complications versus 34 patients (33.7%) in CMG 577. There were two postoperative deaths in CMG 577 (one staging and one debulking procedure), but no postoperative deaths in CMG 579.

For the regression model, LOS was log transformed in order to improve normality of the data. CMG code, procedure, ASA score, day of the week, age, and type of gynaecologist were all significantly associated with LOS (Table 4). Many values for ASA score were missing. Patient weight and fiscal year of surgery were not associated with LOS. In the multivariable regression model, the procedure category, ASA score, age, and type of gynaecologist were all

**Table 1. Demographic characteristics of the patient populations**

	CMG Code 577	CMG Code 579	<i>P</i>
Number of patients	101 patients	606 patients	
Mean age (years) $\pm$ SD	60.1 $\pm$ 14.5	45.1 $\pm$ 13.3	< 0.001
Mean weight (kg) $\pm$ SD	66.4 $\pm$ 12.6	71.3 $\pm$ 16.7	< 0.01
Mean length of stay (days) $\pm$ SD	10.3 $\pm$ 5.4	3.8 $\pm$ 1.7	< 0.001
ASA score, n (%)			
1	12 (11.9)	203 (33.5)	
2	27 (26.7)	240 (39.6)	< 0.001
3	28 (27.7)	51 (8.4)	
4	10 (9.9)	5 (0.8)	
Missing	24 (23.8)	107 (17.7)	
Physician category, n (%)			
Gynaecologist	7 (6.9)	523 (86.3)	
Gynaecologic oncologist	91 (90.1)	83 (13.7)	< 0.001
Missing	3 (3.0)	0	
Fiscal year of surgery, n (%)			
97/98	58 (57.4)	456 (75.2)	0.11
98/99	43 (42.6)	150 (24.8)	
Procedure category, n (%)			
Staging procedure	36 (35.6)		
Debulking procedure	62 (61.4)		
Abdominal surgery		357 (58.9)	NA
Abdominal repair		57 (9.4)	
Vaginal surgery		161 (26.6)	
Laparoscopic surgery		28 (4.6)	
Missing	3 (3.0)	3 (0.5)	

CMG: case mix group; SD: standard deviation; NA: not applicable; ASA: American Society of Anesthesiologists.

significant predictors ( $P < 0.001$ ). Although both procedure category and CMG were significant predictors of LOS by univariable testing, the finer division of patients by procedure category was more strongly associated with LOS. For the CMG code, the  $R^2$  value was 0.328, whereas for procedure category the value was 0.482.

Pairwise testing of the six procedure categories (Tukey test) was performed and adjustments were made for variables of significance found in the multivariable regression model. The results showed that each procedure category described patients with statistically significant differences from one another in LOS ( $P < 0.05$ ).

## DISCUSSION

The results from this study indicate that the type of gynaecologic procedure is a better predictor than the

traditional CMG code of patient LOS and therefore resource requirements. Because the current CMG codes 577 and 579 describe populations with significantly different LOS, these CMG codes group patients with different resource utilization, but the groups are not homogeneous. Analyzing patients according to the type of gynaecologic procedure very accurately separates these two groups of patients into six distinct patient groupings, each with a statistically different LOS. Studies by Chapron et al. and Miskry et al. have demonstrated that the type of gynaecologic procedure is a very important determinant of LOS.<sup>4,5</sup>

From a quality of care perspective, it has become commonplace to share LOS data with physicians in order to improve the efficiency of medical care during times of resource constraint. It is confusing for practising gynaecologists to

**Table 2. Length of stay by procedure type**

Procedure type	No. of patients	Median LOS (days)	Range (days)
CMG 577			
Staging	36	6	3–16
Debulking	62	12	5–30
CMG 579			
Abdominal	357	4	1–19
Abdominal repair	57	4	3–7
Vaginal	161	3	1–13
Laparoscopic	28	1	1–11

Note: The 7 patients with missing procedure designation were not included here.

**Table 3. Complications in patients with length of stay > 1 week**

Type of complication	CMG 579 (n = 606)		CMG 577 (n = 101)	
	No. of patients (%)		No. of patients (%)	
Total no. with LOS > 1week	17 (2.8)		62 (61.4)	
Total no. of pts with complications	8 (1.3)		28 (27.7)	
	Minor comp	Major comp	Minor comp	Major comp
Any complication	2 (0.3)	6 (0.9)	15 (14.9)	15 (14.9)
Postoperative ileus	1 (0.16)		4 (4.0)	
Ileus requiring nasogastric tube		2 (0.3)		4 (4.0)
Massive transfusion		1 (0.16)	3 (3.0)	1 (1.0)
UTI/sepsis	1 (0.16)		6 (5.9)	1 (1.0)
Fluid overload/CHF/RDS			4 (4.0)	4 (4.0)
Repeat laparotomy for hemorrhage		1 (0.16)		5 (5.0)
Other (Seizure/DVT/cardiac/CVA)		3 (0.5)		2 (2.0)
Postoperative death		0 (0)		2 (2.0)

CMG: case mix group; LOS: length of stay; UTI: urinary tract infection; CHF: congestive heart failure; RDS: respiratory distress syndrome; DVT: deep vein thrombosis; CVA: cerebral vascular accident.

compare outcomes and LOS using gynaecologic CMG codes. These code groupings contain too many procedure types, particularly in CMG 579. We have previously emphasized the pitfalls of using physician-based CMG comparisons within or between institutions.<sup>3</sup> Individual gynaecologic practices vary considerably from one physician to another, resulting in significant differences in the frequency and type of surgical procedures. Thus, an approach to providing cost-effective quality care is much more meaningful if it is based on the type of procedure. This approach is much easier for the practising clinician to understand and is also more meaningful for outpatient or other procedures with a short LOS. Hidlebaugh et al. showed that case costing was influenced more by the procedure type than the LOS in cases where the LOS was short.<sup>10</sup>

This is yet another reason to code on the basis of procedure, particularly with the remarkable reductions in LOS that have occurred for a variety of gynaecologic procedures.

There are several limitations to this study. Because some data were collected retrospectively, we did not have complete data on ASA scores for patients in CMG 579. These data should be collected on a routine basis for all surgical patients, because ASA score does influence LOS.<sup>3</sup> The data in this study are now more than five years old, and gynaecologic practices have changed in that time. There has been a significant increase in the use of minimally invasive surgery and outpatient treatment strategies for gynaecologic conditions. The LOS for most gynaecologic procedures has decreased over this time for both major procedure types and laparoscopic surgeries. For example, the use of delayed

**Table 4. Results of multivariable regression analysis of length of stay for CMG 577 and CMG 579**

Characteristic	n	R <sup>2</sup>	P
CMG 579/577	707	0.370	0.001
Procedure (6 categories)	701	0.520	0.001
ASA score*	576	0.196	0.001
Day of the week (7 categories)	707	0.034	0.001
Fiscal year of surgery (2 categories)	707	0.004	0.110
Age	707	0.281	0.001
Weight	681	0.0001	0.825
Physician (2 categories)	704	0.252	0.001

ASA: American Society of Anesthesiologists.

\* ASA score was treated as a continuous variable for the analysis.

primary surgery after neo-adjuvant chemotherapy for ovarian cancer has reduced morbidity and LOS in patients with advanced ovarian cancer.<sup>11</sup>

Another limitation is that we collected data on complications retrospectively, and complications were not analyzed as a separate variable in our model. On reviewing these data, there is an obvious correlation between complication rates, LOS, CMG code, and procedure. Complications resulting in prolonged LOS were uncommon in CMG 579 but were procedure-dependent in CMG 577, with the vast majority of complications occurring in patients having debulking surgery. It is unlikely that including this variable would substantially alter our overall findings, as there were relatively few complications overall. However, including this variable in a statistical model in the future would be of interest, and it will be important to collect this additional information on a prospective basis so that these limitations can be addressed. This will enable investigators to develop and re-evaluate models that group patients into categories of similar resource use, which was the original intent of developing CMG groups.

## **CONCLUSION**

This study has shown that the type of surgical procedure performed predicts LOS more accurately than the traditional CMG codes when applied to CMGs 577 and 579. Instead of two heterogeneous groupings, the population is divided into six distinct groups with statistically significant differences in LOS when compared with one another. This grouping based on procedure is more meaningful than the traditional CMG codes for the practising gynaecologist.

This study indicates that consideration should be given to changing the current CMG codes for gynaecology, basing the new codes on the type of procedure. CMG 577 should be divided into two separate codes, one for debulking procedures and another for cancer staging procedures. The resource use and clinical care considerations differ substantially for these two populations. This justifies their separation and conforms to the original intent of a CMG classification.

With regard to CMG 579, changes in practice patterns and the increased use of minimally invasive surgery (such as laparoscopically assisted vaginal hysterectomy, laparoscopic adnexal surgery, and transvaginal tape procedures for pelvic floor relaxation) have resulted in substantial changes in LOS in the years following this study. Further study will be required to develop new CMG codes for CMG 579 based primarily on the procedure performed. Once this has been done, other factors such as ASA score, age, and surgeon type may prove to be important when comparing utilization data within or between centres.

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