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Hospital-acquired conditions after surgery for gynecologic cancer — An analysis of 82,304 patients

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HIGHLIGHTS

- HACs result in patient suffering and increased costs with potential medical legal consequence.
- Older age, Medicaid insured, open surgery were associated with higher HACs among gynecologic cancer patients.
- HACs were associated with higher hospital charges ($89,324 vs. $31,073; $p < 0.001$).

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ABSTRACT

Objective. To evaluate the hospital-acquired condition (HAC) following oophorectomy and/or hysterectomy for gynecologic cancer patients based on clinical outcomes and costs.

Materials and methods. Data were obtained from the Nationwide Inpatient Sample from 2005 to 2011. Chi-squared and Wilcoxon rank sum two-sample tests and multivariate logistic regression model were used for statistical analysis.

Results. Of 82,304 women (median age: 60 years, range: 1–101), 49,386 (60.0%) had endometrial, 23,510 (28.6%) had ovarian, and 9408 (11.4%) had cervical cancers. Of 135 HAC events, these involved catheter-associated urinary tract infections (n = 47), vascular catheter-associated infection (n = 41), foreign object retained after surgery (n = 19), pressure ulcers (n = 16), manifestation of poor glycemic control (n = 10), and air embolism (n = 2). Older patients (≥60 years) experienced more HACs relative to younger (0.23% vs. 0.09%; OR = 2.13, 95% CI: 1.30–3.50; $p = 0.003$), and patients with Medicaid experienced more HACs compared to those with private insurance (0.35% vs. 0.10%; OR = 3.09, 95% CI: 1.70–5.62; $p < 0.001$). Laparoscopic surgeries were associated with less HACs compared to open surgeries (0.05% vs. 0.19%; OR = 0.41, 95% CI: 0.19–0.90; $p = 0.03$). Length of hospitalization and hospital charges were greater for those with HACs, (12 days vs. 3 days; $p < 0.001$; $89,324 vs. $31,107; $p < 0.001$), respectively.

Conclusion. The odds of hospital-acquired conditions were higher in older patients, open surgery, Medicaid insured with higher associated hospital charges.

1. Introduction

The Institute of Medicine report estimated that 98,000 deaths per year are due to medical errors [1]. In addition, medical error is one of the leading causes of hospital deaths costing institutions 17 to 29 billion dollars per year [1]. Recently, medical errors were reported as the third leading cause of death in the U.S. [2]. Adverse events, including hospital acquired condition (HAC), are usually caused by medical errors [1]. Based on the Center for Medicaid and Medicare Services (CMS), HACs are defined as foreign object, air embolism, blood incompatibility, and pressure ulcers, falls and trauma, catheter-associated urinary tract infection, vascular catheter-associated infection, manifestations of poor glycemic control, surgical site infection, and deep vein thrombosis/pulmonary embolism (DVT/PE) [3].

HACs result in patient suffering, increased costs, and may lead to medical legal consequences to the provider and institutions. Furthermore, a previous report has shown that HAC events resulted in

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$50,000 extra cost per patient admission totaling over 470 million dollars to hospitals [4]. Although prior reports on HACs have focused on head and neck, bariatric, bowel, bladder, prostate, and neurosurgery, there are no studies on gynecologic cancer surgeries and associated HACs [4–13].

In bariatric surgery, 2.85% of patients were found to have associated HACs [6]. Older age, higher BMI, increased comorbidities, and open surgeries were associated with increased risk of HACs [6]. In spinal cancer surgery, the HACs rate was 9.0% in those with dependent functional status [7]. However, these studies lacked information on hospital characteristics such as teaching vs. non-teaching and urban vs. rural. Furthermore, there is a lack of information on the cost associated with HACs, length of hospital stays, and patient's insurance in these studies.

In this current report, we have evaluated the incidence of HACs in women after surgery for endometrial, ovarian, and cervical cancers. Furthermore, we performed an economic analysis to investigate the financial impact associated with HACs in gynecologic cancer surgeries.

2. Methods

2.1. Data source

The National Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP) database was used to conduct this cross-sectional analysis. It is the largest all-payer inpatient healthcare database in the U.S., which represents >96% of the population [14]. NIS contains 20% of patient discharge information stratified by the U.S. community hospitals [14]. This include patient demographics, hospital characteristics, methods of payment, total charges, discharge status, length of stay, severity and comorbidity measure, insurance information, and hospital volume. Since the NIS HCUP database contains de-identified information, the study was exempt from IRB approval.

2.2. Demographics

We identified 82,304 women who underwent surgical treatment for endometrial, ovarian, or cervical cancers between 2005 and 2011 from the NIS database. These patients' demographics, including age, race, socioeconomic status (High, Upper-Middle, Middle, or Low), and insurance type (private, Medicare, Medicaid, uninsured, or other) were obtained from the NIS database. Socioeconomic status was divided into categories based on the quartiles of median household income provided by the database.

2.3. Hospital characteristics

Hospital geographic region (South, Midwest, Northwest, and West), location (Urban and Rural), teaching status (teaching and non-teaching), and surgery type (open and laparoscopic) were derived from the NIS database.

2.4. International classification of diseases, ninth revision (ICD-9) for hospital acquired conditions

HAC events seen in endometrial, ovarian, or cervical cancer surgeries were examined using the following ICD-9 codes: 998.4 and 998.7 (foreign object); 999.1 (air embolism); 999.60–999.63 and 999.69 (blood incompatibility); 707.23 and 707.24 (pressure ulcers); 800–829, 830–839, 850–854, 925–929, 940–949, 991–994 (falls and trauma); 996.64 (catheter-associated urinary tract infection; 999.31–999.33 (vascular catheter-associated infection); 250.10–250.13, 250.20–250.23, 251.0, 249.10–249.11, 249.20–249.21 (manifestations of poor glycemic control). DVT/PE and surgical site infections were not included as HACs in our analysis since it is not related to gynecologic cancer surgeries as defined by CMS [3].

2.5. Economics-hospital charges

The secondary outcome examined was hospital costs. Using the cost-to-charge ratio provided by the Healthcare Cost and Utilization Project, the hospital charges were converted to costs [14]. This cost variable was used to determine the median costs that are associated for each type of HAC event. The added cost was described as the cost for a single HAC event (i.e. 1 vascular catheter-associated infection). This was calculated by taking the difference between the median cost of each type of HAC event and the median cost for those who have not experienced any of these events, which was considered as the referent group. Thus, the total cost was determined by the multiplication of added cost and frequency number for each HAC type.

2.6. Statistical analyses

Analysis were performed using SAS Enterprise Guide 5.1. The demographic and hospital characteristics were compared using Chi-squared and Wilcoxon rank sum two-sample tests. A multivariable logistic model was used to examine HACs as the binary outcome [15]. The variables were included in the model if they obtained p-value ≤0.05 from the univariate analysis. Furthermore, the Hosmer-Lemeshow test was used to test the model for goodness of fit. The association was considered to be statistically significant if two-sided p-value ≤0.05. Additionally, bar graphs were constructed to examine the role of certain patient characteristics on HACs. Charlson Comorbidity Index Score was also adjusted for in the multivariate anlaysis.

3. Results

3.1. Demographics - age, race, SES, insurance type

Of 82,304 patients, 49,386 (60.0%) were diagnosed with endometrial cancer, 23,510 (28.6%) with ovarian cancer, and 9408 (11.4%) with cervical cancer. The demographics, clinical and hospital characteristics are summarized in Table 1. In brief, the median age was 60 years. The majority (60.3%) were White, 6.8% Black, 7.3% Hispanic, 2.5% Asian, and 2.9% others and 20.2% had missing ethnicity information. Twenty-eight percent of patients were of high socioeconomic status, and 49% had private insurance.

3.2. Clinical-hospital characteristics

Most patients underwent open surgery compared to laparoscopic or robotic surgery (82.1% vs. 17.9%). Nearly 95% were treated at urban hospitals and 35% resided in the Southern part of the U.S. About 70% of women had surgery at a teaching hospital compared to 29.6% at non-teaching institutions.

3.3. Hospital acquired conditions

There were 135 HAC events reported out of 82,304 surgeries with an overall rate of 0.16%. Of these HAC cases, 34.8% (n = 47) were catheter-associated urinary tract infection, 30.4% (n = 41) were vascular catheter-associated infection, 14.1% (n = 19) were foreign object, 11.9% (n = 16) were pressure ulcers, 7.4% (n = 10) were manifestation of poor glycemic control, and 1.4% (n = 2) were air embolisms (see Table 2). No blood incompatibilities or falls and trauma were reported from this data. Older patients (≥60 years) experienced more HAC events relative to younger women (0.23% vs. 0.09%; $p < 0.001$), shown in Fig. 1. Additionally, the figure also illustrates that patients with Medicaid coverage experienced a higher percentage of HACs compared to those with private insurance (0.35% vs. 0.10%; $p < 0.001$). Laparoscopic surgeries were associated with less HACs compared to open surgeries (0.05% vs. 0.19%; $p < 0.001$), shown in Fig. 2. Lengths of hospitalization were greater for those with HACs (12 days vs. 3 days; $p < 0.001$). Furthermore,

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