

## CLINICAL ARTICLE

## Obstetrics

# The financial impact of puerperal infections on patients, carers and public hospitals in two regions in Ghana

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## Abstract

**Background:** Puerperal infection (PI) is a known maternal health problem globally. However, there is limited information on its economic impact on patients, carers, and public hospitals in lower-middle-income countries, such as Ghana.

**Methods:** A prospective case-control study was undertaken in two regional hospitals to analyze the cost of PI. A total of 667 and 559 participants were enrolled in the study at the Greater Accra Regional Hospital (GARH) and the Eastern Regional Hospital (ERH), respectively. Total, average and marginal costs were analyzed between patients with and without PI.

**Results:** Within the study period, the prevalence of PI was 9.1% at ERH and 14.9% at GARH. Overall, patients with PI reported excess length of hospital stay (LOS), corresponding to 46.8% and 33.5% increases in average direct cost at ERH and GARH, respectively, compared with their control groups. In almost all cases, the attributable indirect cost was consistent with productivity loss.

**Conclusion:** In both hospitals, patients with PI reported excess LOS and increased direct and indirect costs. The total cost of PI to society, which is the sum of the direct cost, productivity loss, and hospital cost, was higher in Greater Accra than in the Eastern region.

## KEYWORDS

Costing, Financial impact, Ghana, Maternity hospitals, Puerperal infections

## 1 | INTRODUCTION

Although most nations within Sub-Saharan Africa have reduced maternal deaths by half since 1990, maternal mortality is still in-admissibly high. In 2017, about 295 000 women died globally (86% of them from Sub-Saharan Africa), during and following pregnancy and childbirth.<sup>1</sup> About 75% of maternal deaths are caused by severe bleeding (mostly bleeding after childbirth), infections (usually after childbirth), high blood pressure during pregnancy (pre-eclampsia

and eclampsia), complications from delivery, and unsafe abortion.<sup>1</sup> Puerperal sepsis, also known as genital tract sepsis, falls under the group of infections that lead to maternal deaths. WHO defines puerperal sepsis as an infection of the genital tract occurring at any time between onset of rupture of membranes or labor and the 42nd day postpartum in which two or more on a list of specified signs and symptoms are present.<sup>2</sup> Globally, sepsis remains a major cause of death and especially in Sub-Saharan Africa, accounting for 11 million deaths in 2017.<sup>3</sup>

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In Ghana, maternal mortality is still very high, in spite of the many interventions carried out by the government and development partners. Maternal and neonatal health conditions remain a challenge, especially in rural areas and among poor women.<sup>4</sup> From the 2017 Ghana Maternal Health Survey, the maternal mortality ratio for Ghana is 310 deaths per 100 000 live births. Maternal deaths accounted for 14% of all deaths.<sup>5</sup> Two-thirds of maternal deaths were from direct causes related to obstetric complications during pregnancy, labor, or within 42 days after delivery or end of pregnancy. Also, the survey revealed that the cost of care prohibited the payment of other household expenses for 49% of the households of deceased women.<sup>5</sup>

Most publications regarding puerperal infection (PI) focus on the historical aspects of the condition, including the incidence, prevalence, and relevant discoveries such as the development of antiseptic clinical skills. There is a dearth of published information on the financial impact of PI in Sub-Saharan Africa.<sup>6</sup> Healthcare-associated infections contribute to excess mortality, morbidity, and length of stay (LOS).<sup>6,7</sup> Despite the economic and human costs associated with PI there are very few data on these costs in Ghana. This paper examines the financial impact of PI from patient, carer, and provider perspective by analyzing the total, average, and marginal costs borne by patients with and without PI at two public regional hospitals in Ghana.

## 2 | MATERIALS AND METHODS

### 2.1 | Study settings

The study was undertaken at the Obstetrics and Gynecology Department of the Greater Accra Regional Hospital (GARH) and the Eastern Regional Hospital (ERH). In terms of capacity, ERH serves as a secondary referral hospital for about 3.2 million people in the eastern region.<sup>8</sup> The bed capacity of the Obstetrics and Gynecology Department of ERH is 98, equivalent to 26.9% of the total bed capacity of the hospital. The staff strength of the department is 78, comprising 75 medical staff and 3 non-medical staff.<sup>9</sup> Data from the hospital records show that the department records an average of 5523 live births annually, of which spontaneous vaginal delivery (SVD) accounts for about 48% while cesarean sections (CS) accounts for 52%. The GARH also serves about 4.9 million people in the Greater Accra region.<sup>8</sup> The bed capacity of the department is 139, equivalent to 23.2% of the total bed capacity of the hospital. The staff strength of the department is 83, comprising 77 medical and administrative staff and 6 auxiliary staff. Official hospital data show the department records an average of 6341 live births annually, of which 46.3% are spontaneous vaginal deliveries and 53.7% are CS.

The criteria for selecting both hospitals were contingent on four factors. First, both health facilities are secondary public hospitals and can be compared in characteristics (staff strength, clinical equipment, and treatment protocol for PI), especially during data analysis. Second, the readiness of the management of both hospitals to provide the enabling environment for the study. Third, the ease of scaling up the findings to a larger system because both hospitals are Ghana Health Service

facilities. Fourth, both hospitals run a cost recovery system to generate internal revenue for administrative and other expenses while the government pays staff salaries. Hence, the cost of health care in both hospitals is paid partly by the patient and by the government. Patients pay the full expense of transport to and from the hospital as well as the cost of drugs and medical services not fully or partially covered by the government through the national health insurance scheme.

### 2.2 | Study design

A case-control design was used to evaluate the financial impact of PI from both patient and health-system perspectives. A 10% and 31% incidence for the case and control groups were respectively applied to estimate the study sample at 80% statistical power.

Data collection lasted 6 months, spanning July to December 2019. Patients who had a live birth or a stillbirth after 28 weeks of pregnancy or who underwent CS were included. Participants agreed to enrolment and signed an informed consent form. Women who delivered before 28 weeks of pregnancy or had miscarriage, abortion, or their placenta delivered somewhere other than the hospital were excluded from the study as were women who died within 48 hours after delivery. In addition, those lost to follow up after initial enrollment were also excluded for incomplete data. The exclusion criteria took into account expert consultation with medical staff of the hospitals, which includes the fact that if a placenta is delivered elsewhere then the infection could be from outside the hospital.

Those who developed PIs were identified up to 6 weeks (42 days) post-delivery by medical staff through daily inpatient surveillance and post-discharge surveillance. Infected patients were matched with patients with no PI using perfect age match ( $\pm 0$  years) and mode of delivery (CS).

The study received ethical approval from the Ethics Review Committee of the Ghana Health Service. All participants signed the informed consent form.

### 2.3 | Outcomes

The principal outcome of the study was to evaluate the excess LOS and the additional cost attributable to PI in two regional hospitals in Ghana. The extra LOS was defined as the mean difference in hospital bed-days between women with PI and their matched cohorts without PI, whereas the additional cost was estimated as the mean difference in direct cost and productivity losses between women with and without PI.

### 2.4 | Data analysis

#### 2.4.1 | Direct cost

Direct cost was analyzed as the sum of the costs of drugs, laboratory/diagnostic tests, medical procedures, and delivery intervention.

TABLE 1 Descriptive statistics of the total sample cum patients with and without puerperal infection.<sup>a</sup>

	Match sample ERH			Match sample GARH		
	Total (N = 667)	PI (n = 61)	Non-PI (n = 61)	Total (n = 559)	PI (n = 83)	Non-PI (n = 83)
Age, years						
<20	74 (11.1)	3 (4.9)	3 (4.9)	28 (5.0)	3 (3.6)	3 (3.6)
20–30	309 (46.3)	33 (54.1)	33 (54.1)	292 (52.2)	46 (55.4)	46 (55.4)
31–40	270 (40.5)	25 (41.0)	25 (41.0)	227 (40.6)	33 (39.8)	33 (39.8)
>40	14 (2.1)	–	–	12 (2.2)	1 (1.2)	1 (1.2)
All	667 (100.0)	61 (100.0)	61 (100.0)	559 (100.0)	83 (100.0)	83 (100.0)
Mode of delivery						
SVD	223 (33.4)	–	–	109 (19.5)	–	–
Cesarean delivery	443 (66.4)	61 (100.0)	61 (100.0)	450 (80.5)	83 (100.0)	83 (100.0)
Vacuum delivery	1 (0.2)	–	–	–	–	–
All	667 (100.0)	61 (100.0)	61 (100.0)	559 (100.0)	83 (100.0)	83 (100.0)

Abbreviations: ERH, Eastern Regional Hospital; GARH, Greater Accra Regional Hospital; PI, puerperal infection; SVD, spontaneous vaginal delivery.

<sup>a</sup>Values are given as number (percentage).

It also included the cost of transportation and review of PI and treatment, accommodation and other expenses related to hospitalization. The cost of drugs was confirmed with the hospital pharmacy and the costs of treatment related to hospital resource use were derived from the itemized patient bill and receipts.

#### 2.4.2 | Productivity loss

Productivity loss was analyzed as the opportunity cost to participants and their caregivers in relation to hospital admission, i.e. the loss of income during admission and the subsequent 42 days post-delivery. It was computed as the number of lost working days and the corresponding loss in daily wage. For participants engaged in paid jobs, the average daily income was calculated from the 2019 adjusted national average monthly income specified by sex and type of employment and used to value time loss per day.<sup>10</sup> For caregivers aged 18–60 years engaged in informal sector work who could not provide specific monthly income, their indirect cost was computed using the same procedure. The national average monthly wage rather than the actual wage of the participants was used to estimate the indirect cost of productivity loss and enable the generalization of the results.

#### 2.4.3 | Hospital costs

For the purpose of generalizability, an activity-based composite costing method was used to analyze the institutional cost of PI.<sup>11</sup> This is estimated as the sum of all expenditures incurred by the specific health facility, department, or unit. It includes the cost of annualized capital expenditure (e.g. office space and equipment) and recurrent costs, i.e. staff-related cost, cost of clinical support, and the cost of all other consumables used by the Obstetrics and Gynecology Department of the

hospitals within the 2019/20 financial year. The expenditure data were obtained from the finance directorate of each hospital.

#### 2.4.4 | Societal cost

The societal cost of PI was analyzed as the sum of the direct cost, productivity loss, and hospital cost. This was necessary to understand the total cohort cost of PI to society in both regions.

Cost calculations were made in Ghana cedis (GH¢) and converted to 2019 purchasing power parity in US dollars (US\$) using the purchasing power parity value of US\$1.00 to GH¢1.645 and an implied conversion factor of 0.61.<sup>12</sup> Data were presented by hospital and patient age groups, because maternal age is a major risk factor for delivery complications including PI.<sup>13</sup>

### 3 | RESULTS

#### 3.1 | Description of participants

Overall, 667 (ERH) and 559 (GARH) eligible participants who signed the study consent form were studied. About half of participants were 20–30 years old. The majority of the women underwent CS (Table 1). Of the total participants, 61 and 83 had PIs at ERH and GARH, resulting in 9.1% and 14.8% incidence, respectively. All cases of PI occurred among patients who underwent CS.

#### 3.2 | Patient direct cost

In both hospitals, patients with PI recorded higher direct costs compared with their matched cohort. At ERH, the overall average direct

TABLE 2 Direct cost of patients with and without puerperal infection in US\$ (2019-PPP adjusted).<sup>a</sup>

	Eastern Regional Hospital				Greater Accra Regional Hospital			
	N	Average cost, PI	Average cost, Non-PI	Average difference in cost	N	Average cost, PI	Average cost, Non-PI	Average difference in cost
Age, y								
<20	3	842 (617–1507)	624 (582–888)	218	3	1,127 (835–1351)	899 (875–914)	228
20–30	33	1321 (812–4070)	702 (432–1134)	619	46	1411 (903–2740)	1060 (436–2049)	351
31–40	25	1583 (837–4335)	806 (314–1434)	777	33	1659 (903–2741)	904 (619–1346)	755
>40	–	–	–	–	1	1885	1286	599
All	61	1405	747	658	83	1497	995	502

Abbreviations: PI, puerperal infection; PPP, purchasing power parity.

<sup>a</sup>Values are given as average (minimum and maximum) cost in US\$.

cost for patients with PI was US\$1405 (95% confidence interval [CI] \$1197–\$1611) compared with \$747 (95% CI \$685–\$807) for those without PI. At GARH, the observed average direct cost for patients with PI was US\$1497 (95% CI \$1398–\$1596) compared with US\$995 (95% CI \$831–\$1158) for those without infections. Furthermore, 68.4% of the patient direct cost at ERH was attributable to systemic charges defined as the cost of medical consultation 50.2%, cost of drugs 6.7%, cost of infected wound treatment 5.2%, and cost of laboratory tests 6.3%. The remaining 31.6% of the cost resulted from non-systemic expenses, i.e. the cost of transportation and feeding. The disaggregated cost at GARH followed a similar trend. The cost of medical consultation was 55.3% of the direct cost, whereas the cost of laboratory tests, drugs, infected wound treatment, and transportation and feeding amounted to 4.9%, 13.9%, 8.1%, and 17.8%, respectively. Table 2 shows that the highest additional direct cost due to PI was recorded among patients aged 31–40 years (ERH US\$777 and GARH US\$755) whereas the lowest occurred for those younger than 20 years (ERH US\$218 and GARH US\$228).

### 3.3 | Productivity loss

Table 3 illustrates the average productivity loss attributable to PI. It shows that the average productivity losses for patients with PI at ERH and GARH were US\$542 and US\$429 more than the control group. The increase in cost fitted with the estimated average of 3.4 and 2.8 extra productive lost days for women with PI at ERH and GARH, respectively.

### 3.4 | Hospital cost

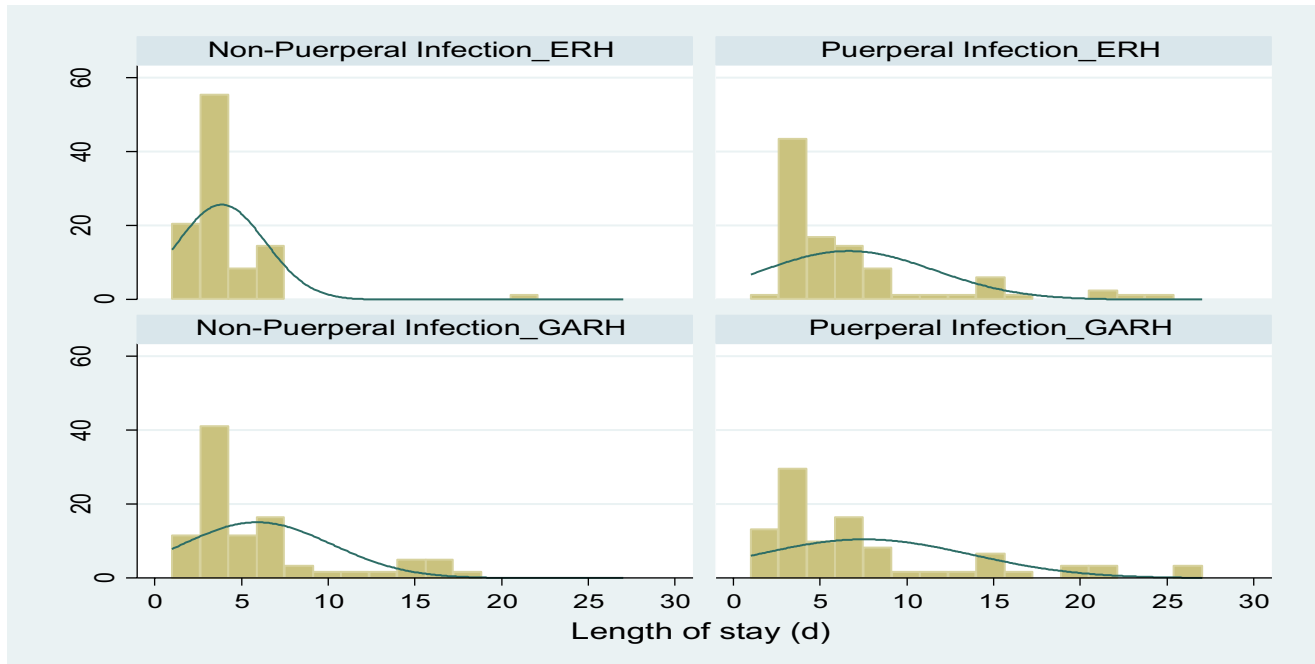
In both hospitals, the estimated difference in average LOS for patients with and without PI was approximately 3 days (ERH 3.4 days; GARH 2.8 days). As shown in Figure 1, there was a statistically significant difference in LOS between the case and control groups at ERH ( $\chi^2 P < 0.000$ ) and GARH ( $\chi^2 P = 0.003$ ). The LOS ranged from 1 to 25 days at GARH and from 2 to 27 days at ERH (Table 4).

TABLE 3 Indirect cost of patients with and without puerperal infection in US\$ (2019 PPP-adjusted).<sup>a</sup>

	Eastern Regional Hospital				Greater Accra Regional Hospital			
	N	Average cost, PI	Average cost, Non-PI	Average difference in cost	N	Average cost, PI	Average cost, Non-PI	Average difference in cost
Age (yrs)								
<20	3	896 (248–1322)	682 (307–633)	214	3	414 (310–496)	235 (223–559)	179
20–30	33	1112 (124–3352)	483 (273–2234)	629	46	1473 (62–7135)	931 (90–5007)	542
31–40	25	1516 (275–8317)	1076 (546–3724)	440	33	2478 (106–13,034)	1095 (124–5399)	1383
>40	–	–	–	–	1	1014	4877	–3863
All	61	1304	762	542	83	1451	1022	429

Abbreviations: PI, puerperal infection; PPP, purchasing power parity.

<sup>a</sup>Values are given as average (minimum and maximum) cost in US\$.



**FIGURE 1** Length of stay for patients with and without puerperal infection at the Eastern Regional Hospital (ERH) and the Greater Accra Regional Hospital (GARH).

The 2019 expenditure for the Obstetrics and Gynecology Department at ERH was US\$5 017 352. The total admissions by the department in the same year were 5174. Given an average LOS of 5.8 days, this corresponds to 30 009 patient bed days, and a daily average cost per patient at the department that amounts to US\$167. For GARH with a similar expenditure pattern, a total admission of 7293 in 2019 and an overall average LOS of 4 days, yielded 29 172 patient bed days, and US\$172 daily average cost per patient.

cost, and 30.9% is productivity loss. Assuming an annual PI prevalence rate of 9.1%, as observed in this study, we estimated the annual societal cost of PI to be US\$828 223 (Table 5). From the derived departmental daily cost per patient at GARH, the estimated additional cost of PI to society per patient amounts to US\$1481, of which 37.1% is institutional cost, 33.9% is a direct cost, and 29% is productivity loss.

### 3.5 | Societal cost

At ERH, the overall estimated additional cost of PI to society per patient is US\$1751, of which 37.6% is direct cost, 31.5% is institutional

## 4 | DISCUSSION

The overall prevalence of PI at GARH was 5.7% higher than in ERH. With infections occurring predominantly among patients who had a CS, surgical procedures may contribute to the infection rate, as well

**TABLE 4** Additional average LOS for patients with and without puerperal infection.<sup>a</sup>

	Eastern Regional Hospital				Greater Accra Regional Hospital			
	N	PI Average LOS	Non-PI Average LOS	Difference in average LOS	N	PI Average LOS	Non-PI Average LOS	Difference in average LOS
Age, y								
<20	3	7 (5-11)	3 (2-5)	4	3	7 (4-10)	5 (4-7)	2
20-30	33	8 (2-27)	4 (1-9)	4	46	6 (2-15)	3 (1-7)	3
31-40	25	8 (2-21)	5 (1-18)	3	33	8 (3-25)	4 (1-7)	4
>40	-	-	-	-	1	15	4	11
All	61	8	5	3	83	7	4	3

Abbreviations: LOS, length of stay; PI, puerperal infection.

<sup>a</sup>Values are given as number (percentage).

TABLE 5 Summary of estimated additional annual costs of PI in US\$ (2019 PPP-adjusted).

	Eastern Regional Hospital			Greater Accra Regional Hospital		
	Mean cost PI	Mean cost Non-PI	Estimated mean additional cost per patient due to PI	Mean cost PI	Mean cost Non-PI	Estimated mean additional cost per patient due to PI
Patient direct costs	1405	747	658	1497	995	502
Productivity loss	1304	762	542	1451	1022	429
Hospital costs	1336	785	551	1204	654	550
Total	4045	2294	1751	4152	2671	1481
			Estimated total annual cost of P <sup>b</sup>			Estimated total annual cost of P <sup>c</sup>
			311,234			543,666
			256,366			464,607
			260,623			595,650
			828,223			1,603,923

Abbreviations: PI, puerperal infection; PPP, purchasing power parity.

<sup>a</sup>Values are given as number (percentage).

<sup>b</sup>Estimated annual number of puerperal infections at ERH is 473

<sup>c</sup>Estimated annual number of puerperal infections at GARH is 1083

as biological and environmental factors.<sup>14</sup> PI patients in both hospitals stayed on average 3 days longer in the hospital than their control group. This means that more hospital resources were used and at a higher treatment cost for patients and society.

The estimated total annual cost of PI suggests that the economic burden of PI on society in the Greater Accra region may be more compared to that in the the eastern eegion. The difference in cost may be associated with regional differences in general economic conditions. For instance, transportation fares to and from the hospitals in both regions are not the same. Likewise, expenses for food and hospital accommodation are not the same. Relatively, prices of goods and services are high in the national capital of Accra compared with other regions of Ghana. Furthermore, with up to 10% of annual maternal deaths in Ghana resulting from PIs,<sup>15</sup> the societal cost of PI may be significantly higher when social cost induced by PI deaths and the life-years saved are taken into account. Therefore, preventive measures that would reduce the PI rate and improve the quality of maternal health may lead to significant cost savings from societal and health system perspectives that may well outbalance the cost of the intervention.

One key limitation of the study was that the estimate of the hospital/institutional cost was derived from the average daily cost at the obstetrics and gynecology departments of the hospitals and so disregards any variation in hospital resource used between participants. Furthermore, the difficulty in quantifying intangible cost that is associated with the emotional and psychological stress suffered by PI patients and their caregivers may imply an underestimation of the total cohort cost.

In conclusion, the study offers scientific evidence of the financial impact of PIs in two regional hospitals in Ghana. It shows that PI leads to excess length of hospital stay (approximately 3 days on average per patient) and increased institutional and patient costs. In terms of the PI associated annual total cost distribution, patients bear two-thirds of the burden. Further, it demonstrates that about half the direct cost incurred by participants relates to the cost of medical consultation, whereas at ERH, for example, more than 30% of the expense was due to non-systemic charges (transportation and feeding). It shows that good infection control at the obstetrics and gynecology departments of the hospitals may lead to efficient hospital resource use, and consequently, reduce the financial burden of PIs on patients and society.

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#### CONFLICTS OF INTEREST

The authors have no conflicts of interest.

## AUTHOR CONTRIBUTIONS

APF, FAA, UE, CA, and NO conceived and designed the study. Data collection tools were reviewed by FAA, UE, EO, CA and NO; data were collected by APF, EO, CA, and NO. APF, UE, and EO analyzed the data. APF and EO wrote the manuscript, and FAA and UE critically reviewed and revised the manuscript. All authors read and approved the final manuscript.

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