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# Decision to delivery interval and predictors for delayed decision to delivery interval among women delivering by emergency caesarean section at a tertiary hospital, Southwestern Uganda: a prospective cohort study

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## Abstract

**Background** Emergency caesarean section (EMCS) is a life-saving procedure carried out with urgency appropriate to the risk posed to the safety of baby and/or the mother. A decision to delivery interval (DDI) is the time from making the decision for cesarean section to delivery of the neonate. Delayed DDI can result in adverse obstetric outcomes and is thus an indicator of poor quality obstetric care. This study aimed to determine the decision to delivery interval and predictors for delayed decision to delivery interval among women delivering by emergency caesarean section at Mbarara Regional Referral Hospital in South western Uganda.

**Methods** We conducted a prospective cohort study on women delivering by emergency caesarean section. Women with category I or II indications as per the World Health Organization (WHO) guidelines were consecutively enrolled from December 2023 to March 2024. Delayed DDI was defined as DDI interval > 75 min. We performed a modified Poisson regression analysis to determine predictors for delayed DDI.

**Results** A total of 504 participants were enrolled. The mean age of the respondents was 26.4 (± 5.25) years. Majority 453 (89.9%) were married, 282 (56.0%) unemployed and 271 (53.8%) had been referred in. Overall median decision to delivery interval was 167.5 min. The proportion of women with delayed DDI was 77.2% (95% CI**:** 73.3–80.8). Predictors for delayed DDI were prior caesarean delivery (aRR 1.15, 95%CI:1.02–1.28), need for stabilisation before surgery (aRR 1.15, 95%CI: 1.01–1.39), need to buy sundries (aRR 1.76, 95%CI: 1.20–2.57), Lack of prior communication to the theatre team (aRR 1.14, 95%CI: 1.03–1.25), unavailability of theatre operating room (aRR 1.23, 95%CI: 1.14–1.32), unavailability of sterile linen (aRR 1.18, 95%CI: 1.03–1.35) and unavailability of anaesthesia provider (aRR 1.40, 95%CI: 1.26–1.55).

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**Conclusion** Majority of the women at MRRH experience delayed DDI and it takes about 3 h to have an EMCS. Women with a prior caesarean section, those who require stabilization before surgery, the need to buy sundries, the lack of operating room, and lack of prior communication to the theatre team, sterile linen and anaesthesia provider are predictors for delayed DDI. We recommend mobilization of resources to address these health system gaps.

**Keywords** Emergency caesarean section, Decision to delivery interval, Predictors, Delivery

## Introduction

Emergency caesarean section (EMCS) is a surgical procedure performed to deliver a fetus in a woman with a life threatening condition to her health and/or the fetus or where vaginal birth puts her life and/or that of the baby at risk [1]. World Health Organization (WHO) classifies unplanned caesarean section into four groups based on their urgency [2] (Supplement 1), with category I and II to be delivered not more than 75 min from decision making as recommended by American College of Obstetricians and Gynecologists (ACOG) and the National Institute for Health and Care Excellence (NICE); in order to optimize birth outcomes [3]. Decision to delivery interval (DDI) is the duration from when a decision to assist the woman to give birth by caesarean section is made to the actual time when the baby is born [4]. It includes patient preparation and consent, patient transfer to operating theatre, administration of anesthesia, skin incision until the extraction of the baby [1]. EMCS when done timely can improve maternal and fetal outcomes if providers of obstetric care respond to emergencies within the recommended time frames [5]. A delayed DDI in EMCS is an indicator of poor quality of care, constitutes a third delay of access to maternal health care and is associated with adverse maternal and neonatal outcomes including birth asphyxia, admissions to neonatal intensive care unit, fresh still births, physical and psychological trauma to the mothers, uterine rupture that ultimately require extensive surgery including hysterectomy [6–9]. The health care structures in Uganda is in such a way that, caesarean delivery services (comprehensive obstetric care) are available at the level of Health centre four, district/general hospitals, regional referral hospitals and national referral hospitals. There is paucity of data on DDI in Uganda, a country that still struggles with access to caesarean section with a caesarean delivery rate standing at 6% [10] with a wide variation across facilities, with health centre IV and private not for profit facilities contributing less than 25% of the caesarean deliveries yet more than 60% of the deliveries occur there [11]. Previous studies in Uganda have shown a high rates of delayed DDIs of up to 4 times above the NICE & WHO recommendation [12]. However, these studies were conducted in urban settings and may not reflect the burden of the challenge in south western Uganda, the population that Mbarara Regional referral Hospital predominantly serves where the patient's socio-economic characteristics and health facility resources may be different. Given the high risk of unfavorable maternal and perinatal outcomes among women who experience a delayed DDI, it is critical to identify those who are likely to have delayed DDI in order to plan interventions tailored for them. Given the high caesarean section are at Mbarara Regional Referral Hospital (MRRH) is 40%, of which 89.2% being EMCS [13, 14], we therefore set forth to study the prevalence of delayed DDI, patient and Health system factors that predict it, at a large public tertiary hospital that serves the rural population of Southwestern Uganda. The findings will inform reforms to improve timely access to caesarean section in order to reduce maternal and neonatal morbidity and mortality.

## Methods

### Study setting, study design and study population

A hospital-based prospective cohort study was conducted from December 2023 to March 2024 at Mbarara Regional Referral Hospital, a public tertiary hospital in south western Uganda. The hospital has a bed capacity of 350 and is referral center as well as the teaching hospital for Mbarara University of Science and Technology. MRRH records for 2022/23 financial year show approximately 9200 deliveries per year of whom over 40% are by caesarean sections with EMCS constituting ~ 89%. Deliveries are managed by midwives, intern doctors, resident doctors in Obstetrics and Gynaecology and specialists, while EMCS are performed by intern doctors, resident doctors of Obstetrics and Gynaecology and specialists. The operating theatre is about is about 300 m from labor ward, and operates 24 h daily with 04 shared operating rooms amongst other surgery specialties.

Our study population were women undergoing emergency caesarean section. All women with category I or category II indication for CS during the study period were included in the study. We did not exclude any woman.

### Sample size and sampling

Sample size was calculated using OpenEpi online software with the assumption of 95% confidence interval and

statistical power of 80%. We considered findings from a study done in Northwest Ethiopia, where women who were referred in from lower facilities were more likely to have a delayed decision to delivery interval compared to those who were not referred in (AOR 2.50, p value < 0.05) [15]. An extra 10% attrition rate was added to obtain 504 participants. We did consecutive sampling for all eligible until the required sample size was attained.

#### Data collection procedures and study variables

Data was collected by four research assistants using interviewer-administered structured questionnaires that was developed after literature review (supplementary file 1) and pretested for this study at Mbarara Municipal council health centre IV on 25(5%) of the eligible women and findings were not included in the final analysis. The data collectors used calibrated clocks that were checked on a daily basis to ensure accuracy in the readings that were placed on the admission area, labor and delivery room, theatre reception and all operating theatre rooms.

The outcome variable was a decision to delivery interval which was defined as the time duration (in minutes) from decision to deliver the woman by emergency caesarean section to the time of delivery of the baby, 3rd stage notwithstanding. These time intervals were collected by trained research assistant assistants who are midwives. They were present at admission and labor wards when decision to deliver by EMCS was made by the clinical team, and in the operating theatre where caesarean sections were being performed. A delayed DDI was defined as a time duration of more than 75 min. The independent variables were classified to four sections: Socio-demographic factors including age, employment, and marital status, level of education and referral status. Obstetric factors included gestational age based on last normal menstrual period or first trimester ultrasound scan, indication for EMCS, parity, prior caesarean birth, Antenatal care attendance. Delivery-related factors included time of the day, day of the week, delay to obtain consent, theatre informed when a decision to deliver a woman by EMCS is made, need for stabilization of a woman before EMCS with intravenous fluids, oxygen, anti-hypertensives or anticonvulsants and health system factors which included: availability of sundries, cadre of surgeon, operating room availability, availability of anesthesia provider, sterile CS sets available, sterile linen available and type of anesthesia as either Spinal or general were examined as potential predictors.

#### Data management and analysis

We used a coded questionnaire to collect data. All raw data was cross-checked for completeness or discrepancies. Data from the questionnaires were entered into Research Electronic Data Capture (REDCap®) software by the PI after which it was exported to STATA software version 17 (*Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC USA) for cleaning and analysis. Continuous variables that are normally distributed are presented as mean ± Standard Deviation while categorical variables are presented as frequencies and percentages. To determine the proportion of women with delayed DDI, decision to delivery interval was categorized as optimal (≤ 75 min) and delayed (> 75 min). We then calculated the proportion of women enrolled in the study who underwent EMCS with DDI > 75 min. To determine predictors for delayed DDI, variables with p-value < 0.2 at bivariable modified Poisson regression were entered into a multivariable regression model. Variables at this level with a p-value < 0.05 were considered statistically significant.

## Results

We screened 620 women undergoing emergency caesarean section during the study period and excluded 116 women, whose caesarean section were not a category I or II indication. We followed them up to the delivery of the neonate and analyzed 504 women for the median decision to delivery interval (DDI), proportion of women with delayed DDI and predictors of delayed decision to delivery interval (Fig. 1).

#### Baseline characteristics of study participants

The mean age of the participants was 26.42 ± 5.35 years, with majority being between 20–34 years (84.1%). More than half of the participants were staying in urban areas (55.4%) and were referrals from lower facilities (53.8%). There was no difference between those with optimal DDI and Delayed DDI apart from the marital status and employment status. Most of the participants 457 (90.7%) were at term and had attended ANC 499 (99%). Among the parous women, 234 (63.6%) were undergoing repeat caesarean section. The proportion of women with a prior caesarean section was higher among those with delayed DDI than those with optimal DDI as shown in Table 1.

#### Health system factors among participants.

A resident doctor was the primary surgeon in 92.4% of the EMCS and majority of women 457 (90.7%) were required to buy sundries for surgery. Absence of health system factors like linen, anaesthesia and caesarean section sets were common among women with delayed DDI as shown in Table 2.

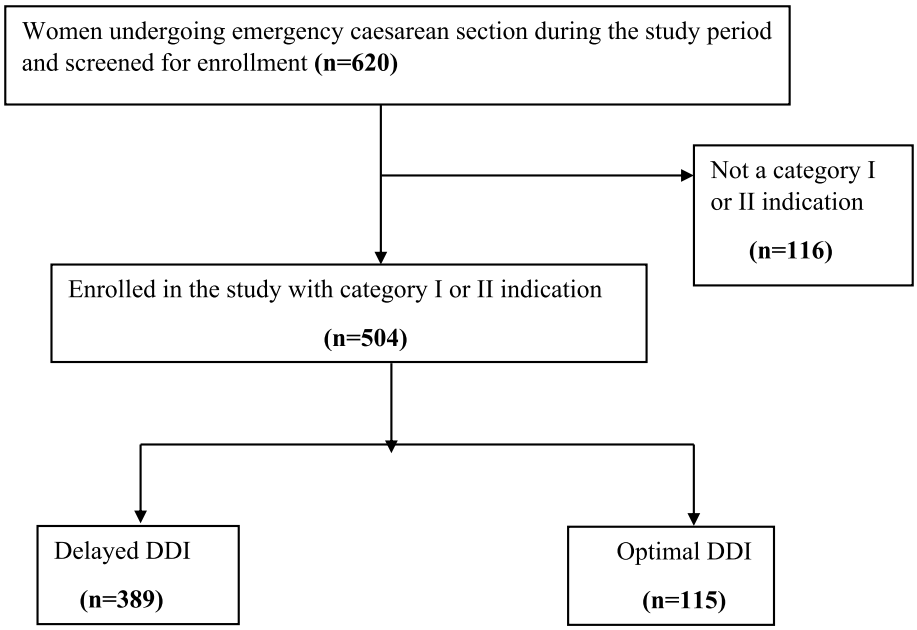


**Fig. 1** Study flow chart

#### Proportion of women with delayed decision to delivery interval

The median DDI was 167.5 min with an interquartile range of 173.5 min. When disaggregated by caesarean section category, the median DDI for Category I and II were 105 and 185 min respectively as shown in Fig. 2 below. Out of the 504 patients recruited in the study, 389 participants had DDI of >75 min hence proportion of delayed DDI at MRRH was 77.2 (95% CI**:** 73.3–80.8) percent.

#### Predictors for delayed decision to delivery interval

The predictors for delayed decision to delivery interval among women delivering by emergency caesarean section were: prior caesarean delivery (aRR 1.15, 95%CI: 1.02–1.28), need to stabilize woman before surgery (aRR 1.15, 95%CI: 1.01–1.39), need to buy sundries (aRR 1.76, 95%CI: 1.20–2.57), theatre team not informed about the woman (aRR 1.14, 95%CI: 1.03–1.25), unavailability of operating room (aRR 1.23, 95%CI: 1.14–1.32), unavailability of sterile linen (aRR 1.18, 95%CI: 1.03–1.35) and unavailability of anaesthesia provider (aRR 1.40, 95% CI: 1.26–1.55) as shown in Table 3 below.

## Discussion

A delayed DDI in EMCS is an indicator of poor quality of care, constitutes a third delay of access to maternal health care and is associated with adverse maternal and neonatal outcomes. The study determined the proportion of, and the predictors for a delayed decision to delivery intervals among women delivering by emergency caesarean section at MRRH, in southwestern Uganda. The proportion of women with delayed DDI at MRRH is high at 77.2% and it takes about 3 h to have an EMCS. Women with a prior caesarean section, those who required stabilization before surgery, a need to buy sundries, and lack of operating room, sterile linen and anesthesia provider were risk factors for delayed DDI.

The study found a median decision to delivery interval of 167.5 min among women delivering by EMCS at Mbarara Regional Referral Hospital (MRRH) which is more than twice the recommended interval by ACOG and NICE [3] [4]. This high median DDI could be attributed to the fact that MRRH receives a significant number of obstetric referrals per day of whom up to 55% are delivered by EMCS [16]. This is coupled with the challenge of inadequate medical supplies and patients are often required to buy out of pocket outside the hospital, few theatre rooms that are shared amongst other surgery specialties, and the fairly distant location of the theatre away from maternity and labour ward which further contribute to the pre-operative delays.

In comparison with our findings, two studies done in Uganda have reported a higher DDI of 330 min and lower DDI of 92 min at Mulago National Referral Hospital and St. Francis Hospital-Nsambya respectively; both of which are beyond the recommended 75 min [6]. The observed difference could be due to the fact that Mulago National Referral Hospital is a public health facility serves a bigger population of approximately 4.6 million people and

**Table 1** Baseline characteristics of the participants ($n = 504$)

| Variable | Total $N = 504$ n/N (%) | Delayed DDI $N = 389$ n/N (%) | Optimal DDI $N = 115$ n/N (%) | *p*-value |
|---|---|---|---|---|
| Age (mean ± SD) | 26.42 (5.35) | 26.46 (5.26) | 26.29 (5.65) | 0.761 |
| Age category | | | | 0.697 |
| Less than 20 years | 36 (7.1) | 26 (6.7) | 10 (8.7) | |
| 20–34 years | 424 (84.2) | 330 (84.8) | 94 (81.7) | |
| 35 years or older | 44 (8.7) | 33 (8.5) | 11 (9.6) | |
| Residence | | | | 0.723 |
| Urban | 279 (55.4) | 217 (55.8) | 62 (53.9) | |
| Rural | 225 (44.6) | 172 (44.2) | 53 (46.1) | |
| Marital status | | | | 0.010* |
| Unmarried | 51 (10.1) | 32 (8.2) | 19 (16.5) | |
| Married | 453 (89.9) | 357 (91.8) | 96 (83.5) | |
| Highest level of education | | | | 0.319 |
| Never Attended | 8 (1.6) | 6 (1.5) | 2 (1.7) | |
| Primary | 191 (37.9) | 140 (36.0) | 51 (44.3) | |
| Secondary | 202 (40.1) | 164 (42.2) | 38 (33.1) | |
| Tertiary | 103 (20.4) | 79 (20.3) | 24 (20.9) | |
| Occupation/employment status | | | | 0.036* |
| Unemployed | 282 (56.0) | 208 (53.5) | 74 (64.4) | |
| Formal employment | 63 (12.5) | 47 (12.1) | 16 (13.9) | |
| Self employed | 159 (31.5) | 134 (34.4) | 25 (21.7) | |
| Referral status | | | | 0.500 |
| No | 233 (46.2) | 183 (47.0) | 50 (43.5) | |
| Yes | 271 (53.8) | 206 (53.0) | 65 (56.5) | |
| Gestational age | | | | 0.300 |
| Less than 34 weeks | 8 (1.6) | 6 (1.5) | 2 (1.7) | |
| 34–36 weeks | 39 (7.7) | 34 (8.7) | 5 (4.3) | |
| 37 weeks or more | 457 (90.7) | 349 (89.8) | 108 (94.0) | |
| Gravidity | | | | 0.463 |
| Prime gravida | 133 (26.4) | 102 (26.2) | 31 (27.0) | |
| Gravida 2–4 | 308 (61.1) | 242 (62.2) | 66 (57.4) | |
| Gravida 5 or higher | 63(12.5) | 45 (11.6) | 18 (15.6) | |
| Prior Caesarean section (Only for Parous women) | | | | 0.007* |
| No | 134 (36.4) | 93 (32.7) | 41 (48.8) | |
| Yes | 234 (63.6) | 191 (67.3) | 43 (51.2) | |
| ANC attended during this pregnancy | | | | 0.358 |
| No | 5 (1.0) | 3 (0.8) | 2 (1.7) | |
| Yes | 499 (99.0) | 386 (99.2) | 113 (98.3) | |
| Time of the operation | | | | 0.430 |
| Day | 273 (54.2) | 207 (53.2) | 66 (57.4) | |
| Night | 231 (45.8) | 182 (46.8) | 49 (42.6) | |
| Day of the week when the decision for EMCS | | | | 0.195 |
| Weekday | 349 (69.2) | 275 (70.7) | 74 (64.3) | |
| Weekend/Public holiday | 155 (30.8) | 114 (29.3) | 41 (35.7) | |
| Need to stabilize the patient first before surgery | | | | 0.212 |
| No | 443 (88.8) | 339 (87.8) | 104 (92.0) | |
| Yes | 56 (11.2) | 47 (12.2) | 9 (8.0) | |

*SD* Standard deviation, *ANC* Antenatal care, *DDI* Decision to delivery interval

* $P < 0.05$

**Table 2** Health system factors affecting decision to delivery intervals of participants ($n = 504$)

| Variable | Total $N = 504$ n/N(%) | Delayed DDI $N = 389$ n/N (%) | Optimal DDI $N = 115$ n/N (%) | *p*-value |
|---|---|---|---|---|
| Patient required to buy sundries for the surgery | | | | < 0.001* |
| No | 47 (9.3) | 19 (4.9) | 28 (24.3) | |
| Yes | 457 (90.7) | 370 (95.1) | 87 (75.7) | |
| Theatre team aware about the patient | | | | < 0.001* |
| No | 183 (36.3) | 161 (41.4) | 22 (19.1) | |
| Yes | 321 (63.7) | 228 (58.6) | 93 (80.9) | |
| Availability of theatre space | | | | < 0.001* |
| No | 83 (16.5) | 82 (21.1) | 1 (0.9) | |
| Yes | 421 (83.5) | 307 (78.9) | 114 (99.1) | |
| Availability of sterile linen | | | | 0.001* |
| No | 47 (9.3) | 45 (11.6) | 2 (1.7) | |
| Yes | 457 (90.7) | 344 (88.4) | 113 (98.3) | |
| Availability of sterile caesarean section sets | | | | 0.072 |
| No | 31 (6.2) | 28 (7.2) | 3 (2.6) | |
| Yes | 473 (93.8) | 361 (92.8) | 112 (97.4) | |
| Availability of Anesthesia provider | | | | < 0.001* |
| No | 218 (43.3) | 205 (52.7) | 13 (11.3) | |
| Yes | 286 (56.7) | 184 (47.3) | 102 (88.7) | |
| Type of anesthesia given | | | | 0.026* |
| General Anesthesia | 18 (3.6) | 10 (2.6) | 8 (7.0) | |
| Spinal Anesthesia | 486 (96.4) | 379 (97.4) | 107 (93.0) | |
| Cadre of the surgeon | | | | 0.154 |
| Specialist | 9 (1.8) | 5 (1.3) | 4 (3.5) | |
| Resident | 466 (92.4) | 359 (92.3) | 107 (93.0) | |
| Intern doctor | 29 (5.8) | 25 (6.4) | 4 (3.5) | |

*DDI* Decision to delivery interval

* $p < 0.05$

receives approximately more than 40 referrals per day, which is higher than what our hospital receives, suffers logistical constraints and thus delays [17]. Secondly, the study was also a retrospective record review and excluded records that had incomplete information. Nsambya on the other hand is a private not for profit and serves a predominantly urban population who pay a fee for the services and thus are less likely to experience challenges of human resources, theatre space, sundries and theatre materials. A study done in Singapore reported a DDI of 57.6 min, which is in keeping with the WHO and NICE recommendation [4]. Singapore, is a high income country, with a robust health system with likely adequate resources, not affected by inadequate human resources, sundries and theatre commodities like our setting [18].

The proportion of women with delayed decision to delivery intervals at MRRH is high at 77.2% (95% CI**:** 73.3–80.8). This finding is similar to studies conducted in Ethiopia with a delayed DDI of 79.7%, a cross-sectional study [15], a retrospective study in Kenya found a delayed DDI of 76% [19] and a cross-sectional study in eastern Uganda with delayed DDI with 79.8% [18]. This is because all the studies were conducted in tertiary facilities in resource limited communities, with probably similar health systems that are usually characterized by high patient numbers, low staffing and often stock outs of medical supplies needed for emergencies cesarean sections [20].

However, a study conducted at Mulago National referral hospital, reported a proportion of women with delayed DDI of 98% [12], which is higher than our study finding of 77.2% (95% CI**:** 73.3–80.8). The National referral serves a far much greater population and receives more than 40 referrals in per day. Their study considered a delayed DDI when the interval was more than 60 min, where as our study considered a delayed DDI at > 75 min and therefore could have found more women than in our study. A cohort study conducted in Bangkok-Thailand found a proportion of women with delayed DDI of 52% [21] and 63.4% in northern Nigeria [22]. Thailand is a

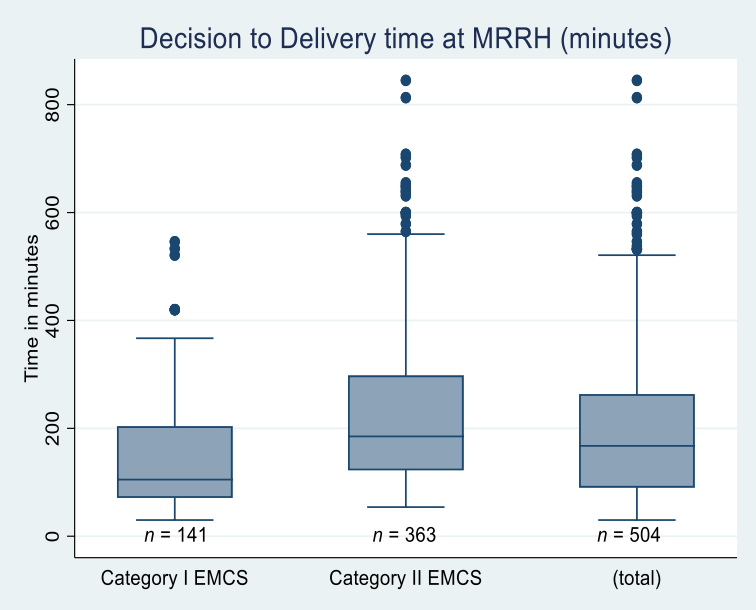


**Fig. 2** Median time to deliver by an emergency caesarean section at MRRH

developed and an upper middle-income country, with a robust health system compared to our setting and less likely affected by inadequate adequate human resources and health supplies. The study in Nigeria was a prospective observational study they excluded women who were referred in for obstetric care including EMCS and all women with pre-eclampsia and eclampsia.

The study found that women with a prior caesarean section had 1.15 fold risk of having a delayed DDI. Similar findings were reported in a retrospective study conducted at a tertiary hospital in Singapore and a cross sectional study in Bahir-Dar city in Ethiopia [7]. This could be because majority of the patients undergoing emergency caesarean section in our study had a prior caesarean section and a category II indication. Priority was given to women who had category I indications of whom very few had a prior caesarean section. The similarity with the other studies could be attributed to the anticipated technical complexity of the surgery due to adhesions and likely which necessitates presence of a senior primary surgeon which can contribute to a delay as they wait for the surgeon [4].

Women who required to be stabilised first prior to having an EMCS were 1.18 times more likely to have a delayed DDI. Unstable patients are at an increased risk of clinical deterioration and thus poor surgical outcomes if they are not optimized before surgery and thus likely to get delayed DDI. Findings documented in a study conducted in Mulago show, women with pre-eclampsia and eclampsia had longer DDI [12]. Contrary to our findings, a cross-sectional study in northern Tanzania, found that women who were unstable were more likely to have shorter DDI, compared to those who did not require resuscitation before surgery [23]. The Study in Tanzania, considered unstable patient to be the one with haemorrhage, with shock and the aim was to perform a caesarean section to control bleeding.

Performing a safe and timely caesarean section requires the availability of key human resources, such as surgeons and anesthesia providers. Studies in Malawi and India have reported similar findings [24, 25]. The availability of anesthesia is directly proportional to waiting times. Critical supplies, sundries, theatre equipment, and linen requiring regular sterilization are also essential. Our study found that women who needed to buy sundries, encountered no available operating room, had an unaware theatre team, lacked sterile linen, or had no anesthesia provider were more likely to experience delayed decision-to-delivery intervals (DDI). When hospital stocks are depleted, patients must mobilize funds to purchase consumables, causing delays [18, 25–27]. Delays are further heightened by a lack of sterile linen and unavailable operating rooms, as reported in prior studies [4, 25, 28]. Effective communication between the obstetric team, midwifery, and anesthesia is crucial for reducing delays. Prior communication allows the theatre team to prepare the necessary supplies and personnel, ensuring minimal delay when the patient arrives [24, 29, 30].

Given the heightened risk for poor maternal and perinatal outcomes associated with delayed decision to

**Table 3** Bivariable and multivariable modified Poisson regression analysis for Predictors for a delayed decision to delivery interval

| Variable | Bivariate analysis cRR (95%CI) | *p*-value | Multivariate analysis aRR (95%CI) | *p*-value |
|---|---|---|---|---|
| Marital status | | | | |
| Un married | Ref | | Ref | |
| Married | 1.26 (1.01–1.56) | 0.039* | 1.12 (0.80–1.55) | 0.510 |
| Employment status | | | | |
| Unemployed/no income | Ref | | Ref | |
| Formal employment | 1.01 (0.86–1.19) | 0.889 | 1.04 (0.89–1.21) | 0.645 |
| Self employed | 1.14 (1.04–1.26) | 0.007* | 1.09 (0.98–1.21) | 0.112 |
| Gestational age | | | | |
| Less than 34weeks | 0.98 (0.65–1.47) | 0.930 | 0.98 (0.89–1.21) | 0.923 |
| 34-36weeks | 1.14 (1.00–1.30) | 0.047* | 1.09 (0.94–1.26) | 0.241 |
| 37 weeks or more | Ref | | Ref | |
| Prior Caesarean section | | | | |
| No | Ref | | Ref | |
| Yes | 1.18 (1.03–1.33) | 0.013* | 1.15 (1.02–1.28) | 0.019* |
| Need to stabilize the patient first | | | | |
| No | Ref | | Ref | |
| Yes | 1.10 (0.97–1.24) | 0.150 | 1.18 (1.01–1.39) | 0.041* |
| Patient required to buy sundries for the surgery | | | | |
| No | Ref | | Ref | |
| Yes | 2.00 (1.41–2.84) | < 0.001* | 1.76 (1.20–2.57) | 0.004* |
| Theatre team aware about the patient | | | | |
| No | 1.23 (1.13–1.35) | < 0.001* | 1.14 (1.03–1.25) | 0.009* |
| Yes | Ref | | Ref | |
| Availability of theatre space | | | | |
| No | 1.35 (1.27–1.44) | < 0.001* | 1.23 (1.14–1.32) | < 0.001* |
| Yes | Ref | | Ref | |
| Availability of sterile linen | | | | |
| No | 1.27 (1.17–1.38) | < 0.001* | 1.18 (1.03–1.35) | 0.017* |
| Yes | Ref | | Ref | |
| Availability of sterile caesarean section sets | | | | |
| No | 1.18 (1.04–1.34) | 0.009* | 1.10 (0.92–1.32) | 0.293 |
| Yes | Ref | | Ref | |
| Availability of Anesthesia | | | | |
| No | 1.46 (1.33–1.60) | < 0.001* | 1.40 (1.26–1.55) | < 0.001* |
| Yes | Ref | | Ref | |
| Type of anesthesia given | | | | |
| General Anesthesia | Ref | | Ref | |
| Spinal Anesthesia | 1.40 (0.93–2.13) | 0.110 | 1.17(0.76–1.79) | 0.471 |
| Cadre of the surgeon | | | | |
| Specialist | Ref | | Ref | |
| Resident | 1.39 (0.77–2.49) | 0.275 | 1.02 (0.58–1.78) | 0.957 |
| Intern doctor | 1.55 (0.85–2.83) | 0.153 | 1.07 (0.59–1.96) | 0.823 |

*cRR* crude risk ratio, *aRR* adjusted risk ratio, *DDI* Decision to delivery interval

* *p* value < 0.05

delivery interval, our findings point towards the need to strengthen innovative interventions in the region aimed at achieving the NICE and WHO recommendation of less than 75 min [1]. This may necessitate use of more innovative and multifaceted approaches to facilitate safe access to cesarean section including addressing health

system factors such as human resource gaps and capacity building, infrastructure development especially having theatre rooms dedicated to obstetric care and close to labour suite, ensuring availability to essential supplies, sundries and medicines required for a cesarean delivery [31]. Additionally, obstetric protocols should be designed to address delays in access to a caesarean section, more especially on patient stabilisation as well as triaging for caesarean delivery, especially women with a previous caesarean delivery since they have an additional risk for poor obstetric outcomes. Future studies are required to assess the implications delayed decision to delivery interval, with regard to maternal and perinatal outcomes, among women undergoing cesarean deliveries in our Ugandan setting as well as the a qualitative study to identify the potential root causes of delayed DDI.

### Strength and limitations of the study

Our study is important because it utilizes prospective methodology to document the delays in the pathway to provision of cesarean delivery in low-resource settings.

Observational studies are prone to Hawthorne effects. The health workers may have known that they are being observed and altered their behavior which may have affected our outcome of interest. To mitigate this, we used the research assistants who were midwives whom we work with on a day to day basis. People may not alter their behavior significantly if they are working with persons whom they are familiar.

## Conclusion

Its takes about 167.5 min for a woman to have an indicated emergency caesarean which is more than twice the recommended time. About 8 in every 10 women delayed to have an indicated emergency caesarean section. Women with a prior caesarean section, those who require stabilization before surgery, patients required to buy sundries no operating room available when mother reached theatre, theatre team not aware about the mother, no sterile linen, and no anesthesia provider available are more likely to have a delayed decision to delivery intervals. We recommend resource mobilization to have more operating rooms and improve on human resources especially the anesthetic providers, availability of health supplies and consumables. Improve communication between maternity, theatre and anaesthesia teams and follow-up study by the obstetrics department to evaluate obstetric outcomes among women with delayed DDI.

### Abbreviations

| | |
|---|---|
| aRR | adjusted risk ratios |
| ACOG | American College of Obstetricians and Gynaecologists |
| CI | Confidence interval |
| CS | Caesarean section |
| EMCS | Emergency caesarean section |
| DDI | Decision to delivery interval |
| MRRH | Mbarara Regional Referral Hospital |
| MUST | Mbarara University of Science and Technology |
| NICE | National Institute for Health and Care Excellence |
| WHO | World Health Organization |

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12884-025-07680-3.

Supplementary Material 1.

Supplementary Material 2. Supplement 1. Classification for urgency of caesarean section by WHO and NICE 2000.

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### Authors' contributions

JB, OB, and JN contributed to the conceptualization and design of the study. JB contributed to study implementation and data acquisition. JB, MK and ST performed formal data analysis. JB, OB, RK, KM and JN contributed to drafting the manuscript. JB, OB, RK, ST, MAA, KM, HML, CK and JN critically reviewed and revised the manuscript for key content. JB prepared the final manuscript. All authors read and approved the final manuscript.

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### Data availability

The datasets generated and analyzed for this study are available from the corresponding author, upon reasonable request.

## Declarations

### Ethics approval and consent to participate

This study was approved by the Faculty of Medicine Research Committee, Mbarara University of Science and Technology Research Ethics Committee under reference number MUST-2023–1206 and Uganda National Council for Science and Technology reference number HS4289ES. Administrative clearance was obtained from the office of the Hospital Director, Mbarara Regional Referral Hospital, prior to conducting the study. Written informed consent was obtained from each study participant before recruitment and participation in the study. Confidentiality of the study participants was ensured by using unique identifiers. Participants were free to withdraw from the study at any time during the study. Recruitment into the study was voluntary and free. At the end of the interview, each participant was given health education on post-partum care. We respected the guidelines of Helsinki and CIOMS-2002 (Council for International Organizations of Medical Sciences) regarding research with humans, avoiding any type of physical or moral harm.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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## Publisher's Note