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Full length article

Trends, causes and factors associated with primary Postpartum Haemorrhage (PPH) in Ireland: A review of one million hospital childbirths

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ABSTRACT

Objective: To analyse temporal trends for primary Postpartum Haemorrhage (PPH), Major Obstetric Haemorrhage (MOH) between 2005 and 2021 and to examine the causes and factors contributing to the risk of PPH during 2017–2021.
Methods: International ICD-10-AM diagnostic codes from hospital discharge records were used to identify cases of PPH. Temporal trends in PPH and MOH incidence were illustrated graphically. Poisson regression was used to assess the time trends and to examine factors associated with the risk of PPH during 2017–2021.
Results: A total of 1,003,799 childbirth hospitalisations were recorded; 5.6% included a diagnosis of primary PPH. Risk increased almost fourfold from 2.5% in 2005 to 9.6% in 2021. The ICD-10 AM code for other immediate primary PPH was recorded for 85% of PPH cases in 2017–2021 whereas a diagnosis of uterine inertia/atony was associated with just 3.6% of the cases. Respectively, trauma-related, tissue-related and thrombin-related causes were associated with one third, 4.2% and 0.5% of cases. A wide range of factors relating to the woman including comorbidities, mode of delivery, labour-related interventions and associated traumas increased risk of PPH but placental complications, especially morbidly adherent placenta, were strong risk factors.
Conclusions: Improvement in detection and anticipation of placental complications may be effective in addressing the increasing trend of PPH, however, the trends of increasing C-sections and other interventions may also need to be addressed while staff education and quality improvement projects will have a role to play.

Introduction

Primary Postpartum Haemorrhage (PPH) is the most common [1] and unpredictable complication of childbirth in developed and developing countries [2]. PPH is the leading cause of maternal morbidity and mortality worldwide [3–9]. Current identified risk factors are listed in Table one. Identifying potential other contributions to the PPH is key to identifying prevention strategies [10,11].

The overarching aim of this study was to identify the yearly trend of primary PPH and MOH from 2005 to 2021. The second part of the study grouped the contributions for PPH from the Hospital In-Patient Enquiry (HIPE) database that were recorded during 2017–2021. The contributions of PPH between 2017–2021 were reviewed for their individual input towards the increasing rise in the causes for PPH using the mnemonic '4T's': tone, trauma, tissue or thrombin. The third aim of this study was to identify the factors associated with the PPH that occurred between 2017–2021 to understand if other potential factors may be associated with the increased PPH trend. See (Fig. 1).

Methods

Data source

A population-based retrospective cohort study was conducted among women who gave birth in hospital between 1 January 2005 and 31 December 2021 in Ireland. Information was obtained from the Hospital In-Patient Enquiry (HIPE) database, is intended to collect information based on in-patient care and treatment following discharge [12]. HIPE reviews the clinical discharge summary and documentation to code procedures and diagnosis [13]. All HIPE data collected, contributes to the health service's decisions on allocation of resources and future planning of services [14] through annual reports [15].

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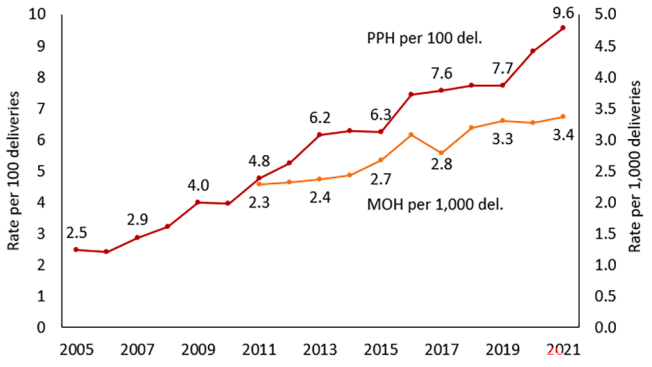


Fig. 1. Trend of primary postpartum haemorrhage (PPH) and major obstetric haemorrhage (MOH) in Ireland, 2005–2021.

Identifying contributions and associations of PPH through HIPE dataset

Application was made to the Hospital Pricing Office (HPO) for HIPE data on all maternity admissions. The researchers reviewed the diagnosis and procedure ICD-10 AM codes recorded for the 24,210 primary PPHs diagnosed during. A total of 240 unique ICD-10 AM codes were associated with the primary PPH cases. Each ICD-10 AM code was reviewed and 17 were classified as potential causes of PPH. Fifteen of the 17 potential causes were classified under one of the four causative headings- Tone, Trauma, Tissue or Thrombin and the frequency of each potential cause was reported. The two unclassified diagnoses were 'other immediate primary postpartum haemorrhage (ICD-10 O72.1)' and 'third stage primary postpartum haemorrhage (ICD-10 O72.0)'.

We examined risk factors for primary PPH to identify the prevalence of other codes among PPHs that occurred between 2017–2021. The codes were identified by name (ICD-10) and the frequency for each was tabulated.

Statistical analysis

Annual risk of primary PPH during 2005–2021 were recorded per 100 deliveries. Data on MOH was recorded in Ireland from 2011, with the risk of MOH reported per 1,000 deliveries over a ten-year period. This is reflected in the results in figure one. Since 2005, the HIPE data used the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification, ICD-10-AM. Hence, the code Z37 was used to select deliveries. Trend analysis involved graphical illustration, calculation of exact Poisson 95 % confidence intervals, and the use of Poisson regression to compare the risk in 2021 to the risk in 2005 (or 2011 for MOH) as well as the annual change in risk. Focusing on the five most recent years, 2017–2021, risk of primary PPH was examined across a wide range of available maternal and delivery characteristics. Poisson regression was used to provide crude and adjusted risk ratios, and their 95 % confidence intervals, for the associations between these characteristics and primary PPH. A stepwise approach was adopted to the multivariable Poisson regression analysis whereby all characteristics were entered into the initial model and characteristics were removed one at a time until only characteristics with highly statistically significant associations, i.e. p-value < 0.001, remained in the final model. Goodness-of-fit tests confirmed that the Poisson regression model was appropriate.

Results

There were 1,003,799 childbirth hospitalisations in Ireland, of which 60,041 or 5.6 % included a diagnosis for primary PPH. Over the 17-year study period, there was a linear, almost four-fold increase in the diagnosis of primary PPH, from 2.5 % in 2005 (95 % confidence interval, CI=2.3–2.6 %) to 9.6 % (95 % CI=9.3–9.8 %; risk ratio, RR=3.87, 95 % CI=3.65–4.10, p-value < 0.001). This is equivalent to an annual increase in risk of 8 % (annual RR=1.08, 95 % CI=1.08–1.09, p-value < 0.001). Major Obstetric Haemorrhage (MOH) also increased by 5 % per year (RR=1.05, 95 % CI=1.04–1.07, p-value < 0.001), from 2.3 (95 % CI=1.8–2.5) per 1,000 in 2011 to 3.4 (95 % CI=2.9–3.9) per 1,000 in 2021, a 58 % increase overall (RR=1.58, 95 % CI=1.28–1.95, p-value < 0.001).

Causes of PPH from 2017 to 2021

The frequency of the 17 identified potential causes of the 24,210 primary PPHs during 2017–2021 is detailed in Table 1. The vast majority of primary PPH was associated with the ICD-10 AM code for other immediate primary PPH (85 %) or the ICD-10 AM code for third-stage primary PPH. A diagnosis of uterine inertia/atony was associated with just 3.6 % of the cases. A trauma-related cause was associated with one third of the primary PPH cases, most commonly episiotomy. Tissue-related causes were associated with just 4.2 % of cases and causes related to thrombin were involved in only 0.5 % of cases. See (Table 2).

Review of the contributing factors of PPH from 2017 to 2021

Table 3 details the maternal and delivery characteristics, and their associations with risk of primary PPH, for the 292,314 women who gave birth in hospital during the study period's five most recent years, 2017–2021. Almost 40 % of the women were giving birth for the first time. They had an elevated risk of primary PPH, most of which was explained by confounding factors. There was little difference in risk among multiparous women with one, two or at least three previous deliveries. Only 9 % of the women were under 25 years of age and they had a lower risk of primary PPH after adjusting for other characteristics. Over 80 % of the women were public patients and they had an elevated risk of PPH that was independent of the other factors considered. There was a variation in risk of PPH by mode of delivery. Compared to Spontaneous Vaginal Delivery (SVD), the risk was 1.07, 1.21 and 1.47 times higher with elective Caesarean Section (C/S), instrumental VD and emergency CS, respectively. Large infant (fetal macrosomia) affected 4 % of deliveries and had an increased risk of PPH of 1.62. The 2 % of women who delivered twins or triplets had twice the risk of PPH. Deliveries complicated by maternal hypertension, polyhydramnios, chorioamnionitis and premature rupture of membranes had an increased risk of PPH.

Labour-related interventions were relatively common, induction (32 %), augmentation (16 %) and epidural (41 %), and were associated with a 1.12–1.23 times higher risk of PPH. One percent of women experienced a 3rd or 4th degree perineal tear and 0.04 % (one in 2500) experienced uterine rupture and both traumas were associated with a doubling of the risk of PPH after adjusting for other factors. An obstetric high vaginal laceration affected one in 500 women (0.2 %) and almost half of the affected women experienced PPH, a 3.5-fold increased risk after controlling for other factors. An obstetric laceration of the cervix was rarer, affecting 0.04 % (one in 2,500 women), but it was an even stronger risk factor for PPH, most affected women had a PPH, a five-fold increase in risk.

Relatively rare labour complications, pyrexia (3 %), prolonged 1st

Table 1
Causes for PPH.

Tone	PPH will occur if the uterus does not contract well enough to arrest bleeding at the placental site.
Trauma	Genital tract trauma may cause bleeding and lead to large volume PPH especially if not identified promptly.
Tissue	Retained products of conception or blood clots will contribute to PPH.
Thrombin	Clotting disorders can lead to PPH alone or in combination with the other factors. These abnormalities may be congenital or acquired [16].

Table 2
Causes of primary postpartum haemorrhage '4T's'.

Cause	N	% of all
All primary PPH	**24,210**	**100**
Other immediate primary postpartum haemorrhage (ICD-10 O72.1)	20,603	85.1
Third-stage primary postpartum haemorrhage (ICD-10 O72.0)	3578	14.8
Tone	**864**	**3.6**
Uterine inertia/atony (ICD-10 O62.2)	864	3.6
Trauma	**7956**	**32.9**
Unintentional cut, puncture, perforation or haemorrhage during surgical and medical care (ICD-10 Y60)	80	0.3
Episiotomy (with primary repair ICD-10-AM 9047200)	6965	28.8
3rd or 4th degree perineal tear (ICD-10 O70.2 or O70.3)	706	2.9
Other obstetric trauma (ICD-10 O71; uterine rupture, postpartum inversion of uterus, cervical tear, high vaginal tear, other)	940	3.9
Tissue	**1023**	**4.2**
Morbidly adherent placenta (ICD-10 O43.2)	340	1.4
Other or unspecified placental disorder (ICD-10 O438, O439)	61	0.3
Placenta praevia (ICD-10 O44)	429	1.8
Placental abruption (ICD-10 O45)	241	1.0
Labour and delivery complicated by vasa previa (ICD-10 O694)	10	0.04
Thrombin	**122**	**0.5**
Postpartum coagulation defects (ICD-10 O72.3)	59	0.2
Disseminated intravascular coagulation (ICD-10 D65)	3	0.01
Other specified haemorrhaging conditions (ICD-10 D698)	2	0.01
Coagulation defect unspecified (ICD-10 D689)	11	0.05
HELLP syndrome- Haemolysis, Elevated Liver, Low Platelets (ICD-10 O142)	52	0.2

stage (1 %) and 2nd stage (3 %), which almost always ended with instrumental or emergency CS delivery, were associated with a 1.29–1.49 times higher risk of PPH.

Placental complications were rare – respectively, 0.2 %, 0.7 % and 0.4 % of deliveries were affected by morbidly adherent placenta, placenta praevia and placental abruption – but they were strong risk factors for PPH. After adjusting for other factors, the risk was more than doubled by placenta praevia and placental abruption and was six times higher with morbidly adherent placenta.

Discussion

PPH & MOH rates

The rate of primary PPH has almost quadrupled from 2.5 % in 2005 to 9.6 % in 2021. The rate of PPH for 2021 can also be compared to previous Irish data on PPH trends. In 1999, the rate of PPH was 1.5 % [17] which indicates a 50 % increase in the rate of PPH from 1999 to 2021 and a continued increase of the rate of PPH year on year for over 30 years. These findings correlate to international research in high-income countries [18-20].

There was a 1.6 times increase in the rate of MOH between 2011 and 2021. The rate of MOH increased in line with the rate of primary PPH. Women who experience a mild or moderate PPH require less intensive medical intervention, while women who experience a MOH will need a multidisciplinary team approach to treat and to prevent end-organ damage and risk to life [21].

In the UK and Ireland's most recent Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries (MBRRACE) report; deaths from PPH were the second most common cause of direct maternal deaths with a rate of 0.64 per 100,000 [19]. PPH needs to be viewed as a clinical manifestation of an underlying condition that requires identification and rapid and effective treatment, rather than a diagnosis [22].

Causes of PPH

Atonic uterus remained the leading cause for PPH at just over 85 %. This rate increased from previous research in Ireland where the rate of atonic PPH was 69 % [17]. Between 2011 and 2021 there has been a 1.3-Fold increase in atonic PPH. Uterine message and the use of uterotonics remain the early treatment modalities [9] but need to be used effectively. Genital tract Trauma- Related PPH accounted for just over 32 %. Within this group, the incidence of episiotomies associated with the rate of PPH was 28.8 %, which may have been related to instrumental births. Other suggestions in the literature mentions a lack of judgement [23] and sub optimal skills [24] can contribute to trauma related PPH [25], in recent years considerable work has been undertaken to reduce and manage severe perineal trauma [9]. Retained tissue-related PPH's occurred in 4.2 %. This group had five results as contributing factors, all placental related complications. Placenta praevia was associated with the leading cause for PPH at 1.8 % (n-429), followed by morbidity adhered placenta at 1.4 % (n-340), placental abruption at1%, vasa praevia at 0.4 % and unspecified placental complications at 0.3 %. The global increase in C/S rates [3] may have contributed to rates for placenta accrete [26] and placenta previa [27]. Thrombin- related PPH's were 0.5 %. HELLP syndrome was the leading cause at 0.2 %, it remains to be seen if point of care (POC) testing of coagulation will assist in decision making where significant haemorrhages occur [28].

Factors association with risk of primary PPH in 2017–2021

Advanced maternal age, nulliparity and delivery by emergency C/S were the leading associated factors impacting the rate of PPH. Morbidly Adherent Placenta (MAP) sequence has evolved into one of the most serious problems in maternity services. The incidence has increased tenfold in the past 50 years due to the increasing number of caesarean sections and has reached seemingly epidemic proportions [25].

Co morbidities

Hypertension (HTN): for women who had pre-existing HTN and became pregnant (0.5 %) the associated rate of PPH was 11.7 %. Women who developed HTN/PET in their pregnancy (5.9 %), the associated rate for PPH was 11.5 %. This reflects similar rates to other international literature [29].

Diabetes: women who had pre-existing diabetes and became pregnant (0.6 %), had a PPH rate of 9.6 %. The rate of PPH was 8.9 % for women who developed Gestational Diabetes Mellitus (GDM), a diagnosis in just under 1:10 (9.9 %) women in our cohort. This has been previously been reported for this cohort of women [30].

Strengths and limitations

The major strength of this study is the longitudinal nature and sources of data which highlights the continued rise in the rate of primary PPH in Ireland. The findings from this research supports the findings in other published research. The time period of data collection provides sufficient numbers to facilitate accurate calculation of the burden of PPH and trend analysis. The first limitation is the data source (HIPE data) which is designed for service management, to collect information on discharge as to the care the person received while an inpatient [31], it was not designed to include the individual person's medical history that may have had an impact on the event. The ICD-10 definition that is used by HIPE for capturing PPH does not accurately reflect the causes of PPH that are used in the clinical area, however by use of other diagnostic codes we were able to elucidate the probable cause and/or associated clinical condition.

Table 3
Maternal and delivery characteristics and associated risk of primary postpartum haemorrhage (PPH) in Ireland, 2017–2021.

		Total, n (%)	PPH, n (%)	Crude risk ratio (95 % CI)	Adjusted risk ratio (95 % CI)
All women who gave birth in hospital		292,314 (100 %)	24,210 (8.3 %)		
Parity	Nulliparous	113,575 (38.9 %)	12,482 (11.0 %)	1.61 (1.56–1.65)	1.13 (1.10–1.17)
	Para 1	101,409 (34.7 %)	6,939 (6.8 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Para 2	51,184 (17.5 %)	3,046 (6.0 %)	0.87 (0.83–0.91)	0.92 (0.88–0.96)
	Para 3+	25,989 (8.9 %)	1,735 (6.7 %)	0.98 (0.93–1.03)	0.99 (0.94–1.05)
Age	15-24yrs	27,617 (9.4 %)	2,235 (8.1 %)	0.95 (0.90–0.99)	0.87 (0.83–0.91)
	25-34yrs	150,901 (51.6 %)	12,911 (8.6 %)	1.00 (Ref. group)	1.00 (Ref. group)
	35 + yrs	113,796 (38.9 %)	9,064 (8.0 %)	0.93 (0.91–0.96)	1.06 (1.03–1.09)
Patient insurance	Public	239,760 (82.0 %)	20,664 (8.6 %)	1.28 (1.23–1.32)	1.32 (1.27–1.37)
	Private	52,554 (18.0 %)	3,546 (6.7 %)	1.00 (Ref. group)	1.00 (Ref. group)
Multiple delivery	No	286,883 (98.1 %)	23,378 (8.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	5,429 (1.9 %)	832 (15.3 %)	1.88 (1.75–2.02)	1.98 (1.85–2.12)
Hypertensive disorder	No	273,384 (93.5 %)	22,029 (8.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Pre-existing	1,598 (0.5 %)	187 (11.7 %)	1.45 (1.26–1.68)	1.39 (1.21–1.61)
	Gestational	17,332 (5.9 %)	1,994 (11.5 %)	1.43 (1.36–1.49)	1.20 (1.14–1.26)
Diabetes	No	261,622 (89.5 %)	21,454 (8.2 %)	1.00 (Ref. group)	
	Pre-existing	1,750 (0.6 %)	167 (9.5 %)	1.16 (1.00–1.36)	
	Gestational	28,942 (9.9 %)	2,589 (8.9 %)	1.09 (1.05–1.14)	
Genitourinary infection in pregnancy	No	290,428 (99.4 %)	24,013 (8.3 %)	1.00 (Ref. group)	
	Yes	1,886 (0.6 %)	197 (10.4 %)	1.26 (1.10–1.45)	
Preterm delivery	No	277,340 (94.9 %)	22,738 (8.2 %)	1.00 (Ref. group)	
	Yes	14,974 (5.1 %)	1,472 (9.8 %)	1.20 (1.14–1.26)	
Premature rupture of membranes	No	274,219 (93.8 %)	22,201 (8.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	18,095 (6.2 %)	2,009 (11.1 %)	1.37 (1.31–1.44)	1.09 (1.04–1.14)
Polyhydramnios	No	286,336 (98.0 %)	23,526 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	5,978 (2.0 %)	684 (11.4 %)	1.39 (1.29–1.50)	1.18 (1.09–1.28)
Infection of amniotic sac/membranes	No	291,034 (99.6 %)	24,023 (8.3 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	1,280 (0.4 %)	187 (14.6 %)	1.77 (1.53–2.04)	1.30 (1.12–1.50)
Induction of labour	No	199,576 (68.3 %)	14,508 (7.3 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	92,738 (31.7 %)	9,702 (10.5 %)	1.44 (1.40–1.48)	1.23 (1.19–1.27)
Augmentation of labour	No	247,106 (84.5 %)	20,157 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	45,208 (15.5 %)	4,053 (9.0 %)	1.10 (1.06–1.14)	1.12 (1.07–1.16)
Neuraxial block during labour	No	172,341 (59.0 %)	11,503 (6.7 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	119,973 (41.0 %)	12,707 (10.6 %)	1.59 (1.55–1.63)	1.16 (1.12–1.19)
Pyrexia during labour	No	283,459 (97.0 %)	22,621 (8.0 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	8,855 (3.0 %)	1,589 (17.9 %)	2.25 (2.14–2.37)	1.49 (1.41–1.57)
Prolonged first stage of labour	No	289,700 (99.1 %)	23,822 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	2,614 (0.9 %)	388 (14.8 %)	1.81 (1.63–2.00)	1.29 (1.16–1.43)
Prolonged second stage of labour	No	283,429 (97.0 %)	22,626 (8.0 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	8,885 (3.0 %)	1,584 (17.8 %)	2.23 (2.12–2.35)	1.37 (1.29–1.44)
Large fetus	No	281,379 (96.3 %)	22,777 (8.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	10,935 (3.7 %)	1,433 (13.1 %)	1.62 (1.53–1.71)	1.44 (1.36–1.52)
Morbidly adherent placenta	No	291,745 (99.8 %)	23,870 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	569 (0.2 %)	340 (59.8 %)	7.30 (6.56–8.13)	6.02 (5.40–6.72)

(*continued on next page*)

Table 3 (*continued*)

		Total, n (%)	PPH, n (%)	Crude risk ratio (95 % CI)	Adjusted risk ratio (95 % CI)
Placenta praevia	No	290,152 (99.3 %)	23,781 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	2,162 (0.7 %)	429 (19.8 %)	2.42 (2.20–2.66)	2.55 (2.31–2.82)
Placental abruption	No	291,242 (99.6 %)	23,969 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	1,072 (0.4 %)	241 (22.5 %)	2.73 (2.41–3.10)	2.44 (2.14–2.77)
Episiotomy	No	241,554 (82.6 %)	17,245 (7.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	50,760 (17.4 %)	6,965 (13.7 %)	1.92 (1.87–1.98)	1.54 (1.48–1.61)
3rd or 4th degree perineal tear	No	288,790 (98.8 %)	23,504 (8.1 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	3,524 (1.2 %)	706 (20.0 %)	2.46 (2.28–2.65)	2.09 (1.94–2.26)
Uterine rupture	No	292,186 (99.96 %)	24,178 (8.3 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	128 (0.04 %)	32 (25.0 %)	3.02 (2.14–4.27)	2.20 (1.55–3.11)
Obstetric high vaginal laceration	No	291,833 (99.8 %)	23,980 (8.2 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	481 (0.2 %)	230 (47.8 %)	5.82 (5.11–6.63)	3.56 (3.12–4.06)
Obstetric laceration of cervix	No	292,188 (99.96 %)	24,138 (8.3 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Yes	126 (0.04 %)	72 (57.1 %)	6.92 (5.49–8.72)	4.95 (3.92–6.24)
Mode of delivery	SVD	148,932 (50.9 %)	9,858 (6.6 %)	1.00 (Ref. group)	1.00 (Ref. group)
	Instrumental VD	42,368 (14.5 %)	5,991 (14.1 %)	2.14 (2.07–2.21)	1.21 (1.15–1.26)
	Elective CS	58,372 (20.0 %)	3,431 (5.9 %)	0.89 (0.85–0.92)	1.07 (1.03–1.12)
	Emergency CS	42,642 (14.6 %)	4,930 (11.6 %)	1.75 (1.69–1.81)	1.47 (1.41–1.53)

Note: Parity was not recorded for 157 (0.05%) women.

Impact on clinical practice

The findings from this research highlight new insight for staff of the continued increase rate of primary PPH and MOH. This research outlines the leading cause of atony has increased in the last two decades, and the increasing C/S rate has impacted on the rate of primary PPH. The contributing factors of a PPH will inform clinical staff of need to review current practice as trend of PPH may reduce if the rate of contributing factors decrease. Further research is required to identify the cause of the continued rise of PPH from atonic uterus.

Impact on health policy

The National Perinatal Epidemiology Centre (NPEC) is a clinical audit centre located within the Department of Obstetrics and Gynaecology, University College Cork. The NPEC work collaboratively with the maternity services to effectively utilise clinical audit data and epidemiological evidence, to translate these insights into tangible improvements in maternity care for families throughout Ireland. One audit the NPEC manages is the Severe Maternal Morbidity Audit, within this clinical audit details on major obstetric haemorrhage (MOH) is collected. Following the recognition of this increase a postpartum haemorrhage quality improvement initiative (PPHQII) was established. The initiative is a joint venture between the National Women Infants Health Programme (NWIHP) and the NPEC. A steering committee with representatives from the State Claims Agency, Midwifery, Institute of Obstetricians and Gynaecologists, Haematology, Blood Transfusion Service, Health Service Quality Improvement, patient advocacy service was convened to address the increasing incidence. The committee has undertaken the following work, an unit preparedness study, PPH data collection, local champions network, workshops – data collection/case reviews, staff debrief and patient communication. The National Steering Committee members were instrumental in the PPH guideline development. Collaborating with the designated local champions within each unit, toolkits are being developed. Each toolkit is tailored to a specific topic and are accessible for universal use through the PPHQII website. Throughout this initiative, we have adhered to the principles of quality improvement (QI) to establish a robust procedural process [32].

Impact on research

The novel approaches taken in this research to use the 'four T's' mnemonic and associated factors of PPH has not been used in research previously. The associated factors that contributed toward the causes of PPH should expand to include more maternal characteristics including BMI. Documentation of the events of the PPH needs to improve as current coding may not actually record all episodes of PPH. Current coding with HIPE does not correspond to the four causes of PPH (4 T mnemonic), and this may result in the rate not being accurate recorded.

Conclusion and recommendations

The overall increasing trend of PPH nationally and globally is a known occurrence. Further improvement in detection and anticipation of placental complications is likely to be effective in addressing the increasing trend, however, potential improvements may be undone if the trends of increasing C/S and other interventions continue. Staff engaging in quality improvement projects also have a role to play in addressing primary PPH.

CRediT authorship contribution statement

Imelda Fitzgerald: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Paul Corcoran:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Validation, Writing – review & editing. **Joye McKernan:** Supervision, Visualization, Writing – review & editing. **Rhona O. Connell:** Supervision, Visualization, Writing – review & editing. **Richard A. Greene:** Conceptualization, Data curation, Formal analysis, Investigation, Supervision, Validation, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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