



Confidential Maternal Death Enquiry in Ireland

Report for 2013 - 2015

December 2017



MDE

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Maternal Death Enquiry
Ireland

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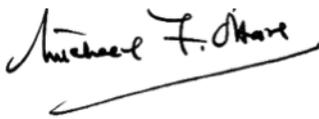
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Foreword

Publication of this third Maternal Death Enquiry (MDE) Ireland report coincides with the release of the 2017 report incorporating Irish data in the long-established UK Confidential Enquiry into Maternal Deaths. It covers the same timeframe as the latter, and provides an update on mortality data included in earlier MDE Ireland reports published in August 2012 and February 2015. A formal working relationship initially developed with CEMACH (subsequently CMACE) in 2009 has been consolidated by an agreement with colleagues based at MBRRACE-UK in Oxford. Most recently, this has resulted in (i) 'Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland.' Confidential Enquiries into Maternal Deaths and Morbidity 2013–15 published in December 2017; and (ii) Data Briefs 1 and 2 published by MDE Ireland in December 2015 and 2016. It represents another and important landmark in the longstanding relationship between professional colleagues involved in maternity services in Ireland and the UK. The revised reporting and assessment procedures now result in annual reports, with much earlier access to data and emerging trends.

I commend both reports to all who have any involvement or interest in the care of pregnant, or recently pregnant, women in Ireland.



Michael F O'Hare MD, FRCPI, FRCOG

Chairman

Joint Institute of Obstetricians & Gynaecologists/HSE Working Group on Maternal Mortality

Acknowledgements

The content of this report reflects the commitment and hard work of many people both within Ireland and the UK. MDE Ireland extends sincere thanks to all healthcare professionals who have contributed data to this confidential enquiry. Their support is essential to the success of the enquiry process. In particular, we gratefully acknowledge the commitment of unit coordinators and coroners in notifying cases. Particular thanks are due to the dedicated multidisciplinary Irish assessors (see Appendix 1). Their clinical expertise in reviewing maternal death cases is invaluable in identifying actions to improve future care of all pregnant women. As with UK assessors, their work is carried out pro bono and in their own time. We would also like to acknowledge the members of the Working Group on Maternal Mortality in Ireland (Appendix 2) for their intellectual input and advice on the confidential enquiry process in the context of Ireland. Within the UK, MDE Ireland would again like to acknowledge and extend sincere thanks to all members of the Oxford based MBRRACE-UK team led by Professors Jenny Kurinczuk and Marian Knight (Appendix 3). Their support and advice is much appreciated.

Executive summary

This is the third Maternal Death Enquiry (MDE) Ireland report, and follows on from previous reports covering the period 2009-2014. In common with the UK, reports are now produced annually and cover triennia on a rolling basis. Since its inception in 2009, MDE Ireland has used the validated and respected UK Confidential Enquiry methodology. The UK CEMD is the longest running programme and widely considered the gold standard for confidential enquiries into maternal deaths worldwide.

In 2013, governance of the UK CEMD (formerly CEMACH, laterally CMACE) was transferred to MBRRACE-UK, (Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries). MBRRACE-UK is led from the National Perinatal Epidemiology Unit (NPEU) at the University of Oxford.

Publication of this report coincides with the latest report from MBRRACE-UK, 'Saving Lives, Improving Mother's Care: Lessons learned to inform future maternity care from the UK and Ireland. Confidential Enquiries into Maternal Death and Morbidity 2013 – 2015'.¹ During the same triennium, a total of 15 maternal deaths, occurring during or within 42 days of pregnancy end, were reported to MDE Ireland. Of these 15 deaths, 4 were classified as direct maternal deaths (due to obstetric causes), 9 as indirect maternal deaths (due to pre-existing medical or mental disorders exacerbated by pregnancy), and the remaining 2 were attributed to coincidental causes (not due to direct or indirect causes). There was no evidence of clustering in any one maternity hospital.

Taking account of the relatively small number of maternal deaths in Ireland, fluctuation in the Maternal Mortality Rate (MMR) is inevitable and must be interpreted with caution. For the triennium 2013 – 2015, the MMR in Ireland was 6.5 per 100,000 maternities (95% CI 3.5-11.2). The rates for 2011 - 2013 and 2012 – 2014 were 10.4 and 9.8 per 100,000 maternities respectively. The apparent decrease in MMR for the triennium 2013 - 2015 is not statistically significant and is similar to the UK MMR of 8.76 per 100,000 maternities (95% CI 7.59-10.05).

For the years 2013-2015 case ascertainment by MDE Ireland (direct and indirect) was significantly greater than that by the civil death registration system.² This issue is not unique to Ireland as underestimation of maternal deaths using civil death registration systems, even in developed countries, has been acknowledged by the World Health Organisation (WHO).

The majority of deaths in the years 2013 - 2015 were from indirect causes, i.e. from pre-existing disorders exacerbated by pregnancy. The proportion of maternal deaths due to direct and indirect causes was 30% and 70% respectively. This reflects findings in the UK and underscores the importance of preconception counselling for all women of childbearing years with pre-existing medical and mental health disorders. It also serves to emphasise the importance of a comprehensive history being documented at the first booking visit to a maternity unit.

1 Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013–15. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2017.

2 Central Statistics Office. [2017] Vital Statistics Annual Report 2015. Cork. Available at: <http://www.cso.ie/en/releasesandpublications/ep/pvsar/vitalstatisticsannualreport2015/infantmortalitystillbirthsandmaternalmortality2015/>

As in the UK,

- Cardiac disease was the single commonest cause in Ireland of maternal death.
- Maternal suicide was the leading cause of direct maternal deaths occurring between six weeks and one year after pregnancy end.

In the seven years 2009-2015, one third of women who died were still pregnant at the time of death. The majority (58%) of direct maternal deaths occurred in an Intensive Care Unit (ICU). This highlights the importance of good communication between ICU in adult hospitals and stand-alone maternity units and also adherence to national guidelines for care of critically ill women in obstetrics. In contrast, indirect maternal deaths occurred in a variety of settings.

There was a trend in 2009-15 towards over-representation of women born outside of Ireland in reported deaths, but this did not reach statistical significance. Successive UK CEMD reports have found an increased risk of maternal death among migrant ethnic minorities.

While the numbers of maternal deaths in specific age groups in 2009-2015 were small, there was evidence of an increasing MMR among women aged 35 years and above.

In summary, the findings of this report in conjunction with the 'Saving Lives, Improving Mother's Care: Lessons learned to inform future maternity care from the UK and Ireland. Confidential Enquiries into Maternal Death and Morbidity 2013 – 2015' highlight the need for continuing vigilance and ongoing enquiries into maternal deaths in Ireland in order to identify key factors impacting on adverse maternal outcomes. It is imperative that lessons are learned from such deaths to inform continuing improvements in maternity services.

Recommendations

Based on the CEMD findings in Ireland 2013 – 2015, and previous reports, MDE Ireland makes the following recommendations within the context of Ireland. Recommendations from previous reports are restated as improvements are still applicable.

- All health care professionals within the Irish maternity services should be aware of recommendations and lessons contained within the recent MBRRACE-UK 'Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013 –15' report.³
- Irrespective of cause, all maternal deaths occurring during or within in one year of giving birth, ectopic pregnancy, miscarriage or termination of pregnancy should be notified to MDE Ireland in order to support the enquiry process.
- A question on pregnancy status at time of death, (similar to that on the medical death certificate), should be added to the Coroner's death certificate.
- Improvements in communication between clinicians in the event of serious maternal illness are recommended.
- Women with medical disorders should receive preconception advice and ideally have their medical conditions reviewed prior to pregnancy. This will need to be provided by their GPs and specialist physicians in conjunction with the obstetric services.
- Pregnant patients with pre-existing medical and mental health disorders should undergo risk assessment at booking and should be afforded high priority by colleagues in other medical disciplines when referred for assessment.
- Women with any past history of psychotic disorder, even where not diagnosed as postpartum psychosis or bipolar disorder, should be regarded as at increased risk in future postpartum periods and should be referred to mental health services in pregnancy to receive an individualised assessment of risk.
- Implementation of recommendations of recently published HSE report "Specialist Perinatal Mental Health Services: Model of Care for Ireland", particularly in relation to a mother and baby unit.⁴

³ Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013–15. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2017.

⁴ Specialist Perinatal Mental Health Services: Model of Care for Ireland. HSE Mental Health Division 2017. Available at: http://www.hse.ie/eng/services/list/4/Mental_Health_Services/Specialist-Perinatal-Mental-Health/

Confidential Maternal Death Enquiry UK and Ireland 2013-2015

The Confidential Maternal Death Enquiry (CEMD) was initiated in England and Wales in 1952 and became UK - wide in the 1980s. Ireland became a participant in the Enquiry in 2009. Learning points from successive CEMD reports have informed practice in the maternity services for over six decades. Their overwhelming strength has been the impact of their findings on improving standards of care and clinical governance in the UK maternity services, and further afield, including Ireland.

The aim of the Enquiry is to investigate why some women die during or shortly after pregnancy, and to learn how such tragedies might be avoided in the future. We can thus ensure that all pregnant and recently delivered women receive safe, high quality care delivered in settings appropriate to their individual needs, and ensure that women with pre-existing disorders have had their treatment optimised prior to conception.

In 2013, governance of the UK CEMD was transferred to MBRRACE-UK, (Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries).

MBRRACE-UK is led from the National Perinatal Epidemiology Unit (NPEU) at the University of Oxford by Professors Jenny Kurinczuk and Marian Knight. With the support of the HSE and the Institute of Obstetricians and Gynaecologists, MDE Ireland has entered into agreement with MBRRACE-UK to ensure continuing Irish involvement with the UK based Enquiry. MBRRACE-UK has revised

and updated the process for data collection and analysis on maternal deaths including 'late' maternal deaths, and reports are now published annually rather than triennially. Topic-specific chapters on individual causes of death now appear once every three years on a cyclical basis, alongside a surveillance chapter reporting three years of statistical data for the UK. Importantly, the focus is not in attributing blame, but on improving future mothers' care.

The first MBRRACE-UK report, covering the years from 2009 to 2012 was published in December 2014. For the first time in the sixty year history of the UK CEMD, this report included detailed Confidential Enquiries into the care of women who died during or after pregnancy in Ireland. For consistency and comparability with previous CEMD reports, surveillance data on maternal mortality rates and trends does not include Irish data. However, MDE Ireland continues to analyse and publish surveillance data on maternal mortality occurring in Ireland independently. The themed review topics in the 2017 MBRRACE-UK report include neurological conditions, other medical and surgical conditions, sepsis, anaesthetic complications, haemorrhage, amniotic fluid embolism and severe morbidity from psychosis.⁵ MDE Ireland recommends that all health care professionals within the Irish maternity services should be aware of recommendations and lessons contained within this report, available at: <http://www.ucc.ie/en/mde/publications/>

⁵ Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013–15. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2017.

The Confidential Enquiry into Maternal Deaths: Definitions and Methodology

Definitions and classification of maternal deaths used by the UK CEMD are outlined in Table 1. In recognition of the importance of maternal suicide and its direct link to pregnancy, most recent WHO guidance on classification of maternal mortality (ICD-MM,

WHO 2012) has recommended that maternal deaths due to suicide are classified as direct rather than indirect maternal deaths.⁶ MBRRACE-UK and MDE Ireland have adopted the changed classification.

Table 1: Definitions of Maternal Deaths: (World Health Organisation 2010)

Maternal Death	Deaths of women while pregnant or within 42 days of the end of the pregnancy* from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes
Direct	Deaths resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above.
Indirect	Deaths resulting from previous existing disease, or disease that developed during pregnancy and which was not the result of direct obstetric causes, but which was aggravated by the physiological effects of pregnancy.
Late	Deaths occurring between 42 days and 1 year after the pregnancy end* that are the result of Direct or Indirect maternal causes.
Coincidental †	Deaths from unrelated causes which happen to occur in pregnancy or the puerperium.

* Includes giving birth, ectopic pregnancy, miscarriage or termination of pregnancy.
 † Termed "Fortuitous" in the International Classification of Diseases (ICD)

⁶ WHO. The WHO application of ICD-10 to deaths during pregnancy, childbirth and puerperium: ICD-MM. Geneva: World Health Organization, 2012

Table 2: WHO ICD-MM classification and groups of underlying causes of death during pregnancy, childbirth and the puerperium* 7

Type	Group number/name	Examples of potential causes of death
Maternal death: direct	1. Pregnancy with abortive outcome	Abortion, miscarriage, ectopic pregnancy and other conditions leading to maternal death and a pregnancy with abortive outcome
Maternal death: direct	2. Hypertensive disorders in pregnancy, childbirth and the puerperium	Oedema, proteinuria and hypertensive disorders in pregnancy, childbirth or the puerperium
Maternal death: direct	3. Obstetric Haemorrhage	Obstetric diseases or conditions directly associated with haemorrhage
Maternal death: direct	4. Pregnancy related infection	Pregnancy-related, infection-based diseases or conditions
Maternal death: direct	5. Other obstetric complications	All other direct obstetric conditions not included in groups 1-4
Maternal death: direct	6. Unanticipated complications of management	Severe adverse effects and other unanticipated complications of medical and surgical care during pregnancy, childbirth or the puerperium
Maternal death: indirect	7. Non-obstetric complications	Non-obstetric conditions <ul style="list-style-type: none"> · Cardiac disease (including pre-existing hypertension) · Endocrine conditions · Gastrointestinal tract conditions · Central nervous system conditions · Respiratory conditions · Genitourinary conditions · Autoimmune disorders · Skeletal diseases · Psychiatric disorders · Neoplasms · Infections that are not a direct result of pregnancy
Maternal death: unspecified	8. Unknown/undetermined	Death in pregnancy, childbirth and the puerperium where the underlying cause is unknown or was not determined
Death in pregnancy, childbirth and the puerperium	9. Coincidental	Death in pregnancy, childbirth and the puerperium due to external causes

7 WHO. The WHO application of ICD-10 to deaths during pregnancy, childbirth and puerperium: ICD-MM. Geneva: World Health Organization, 2012

Calculating Maternal Mortality Rates

Maternal mortality rates (MMR) are based on maternal deaths due to direct or indirect causes and do not include deaths due to coincidental causes. It is international practice to use the number of live births as the denominator for MMR, whereas the number of maternities is used by the UK and Ireland CEMD to calculate rates, as this represents a figure closer to the true number of women at risk. The total of estimated maternities

(including miscarriage, ectopic pregnancy and therapeutic termination) is sometimes used as a denominator. However, this denominator is inaccurate and underestimated. In view of this, MDE Ireland has calculated MMR using published national data of maternities, i.e. women giving birth to a live or stillbirth with birth weight of $\geq 500\text{g}$.⁸ These data were also used to calculate age and parity specific mortality rates.

Identifying Maternal Deaths in Ireland

MDE Ireland has adopted a proactive approach to case ascertainment similar to that used historically by UK CEMD. This includes a nationwide network reporting directly to MDE Ireland from a variety of sources. The majority of cases are reported directly by the maternity unit responsible for the woman's care during pregnancy. Additional sources include general hospitals, coroners, pathologists, general practitioners and other healthcare professionals in the community. Historically, the overall number of maternal deaths identified by the UK CEMD methodology has always exceeded twice the number of those officially reported by the UK Office of National Statistics (ONS). This is because not all maternal deaths are recorded as such on death certificates. In Ireland, the Central Statistics Office (CSO) collates statistics on

deaths from death registration data gathered by the General Register Office (GRO). Since the inception of the Enquiry in 2009, the number of maternal deaths identified by MDE Ireland (direct and indirect) has been significantly greater than the number identified by death registration alone.⁹

Underestimation of maternal mortality rates by civil death registration systems alone is not unique to Ireland and the UK. In Europe, underestimation of maternal deaths has been reported to vary between 30% and 50%.¹⁰ In acknowledgement of issues affecting MMR as reported by civil death registration systems globally, WHO has proposed systematically weighting the official statistics reported by developed countries by a factor of 1.5.¹¹

8 Healthcare Pricing Office. [2017] Perinatal Statistics Report 2015. Dublin: Health Service Executive.

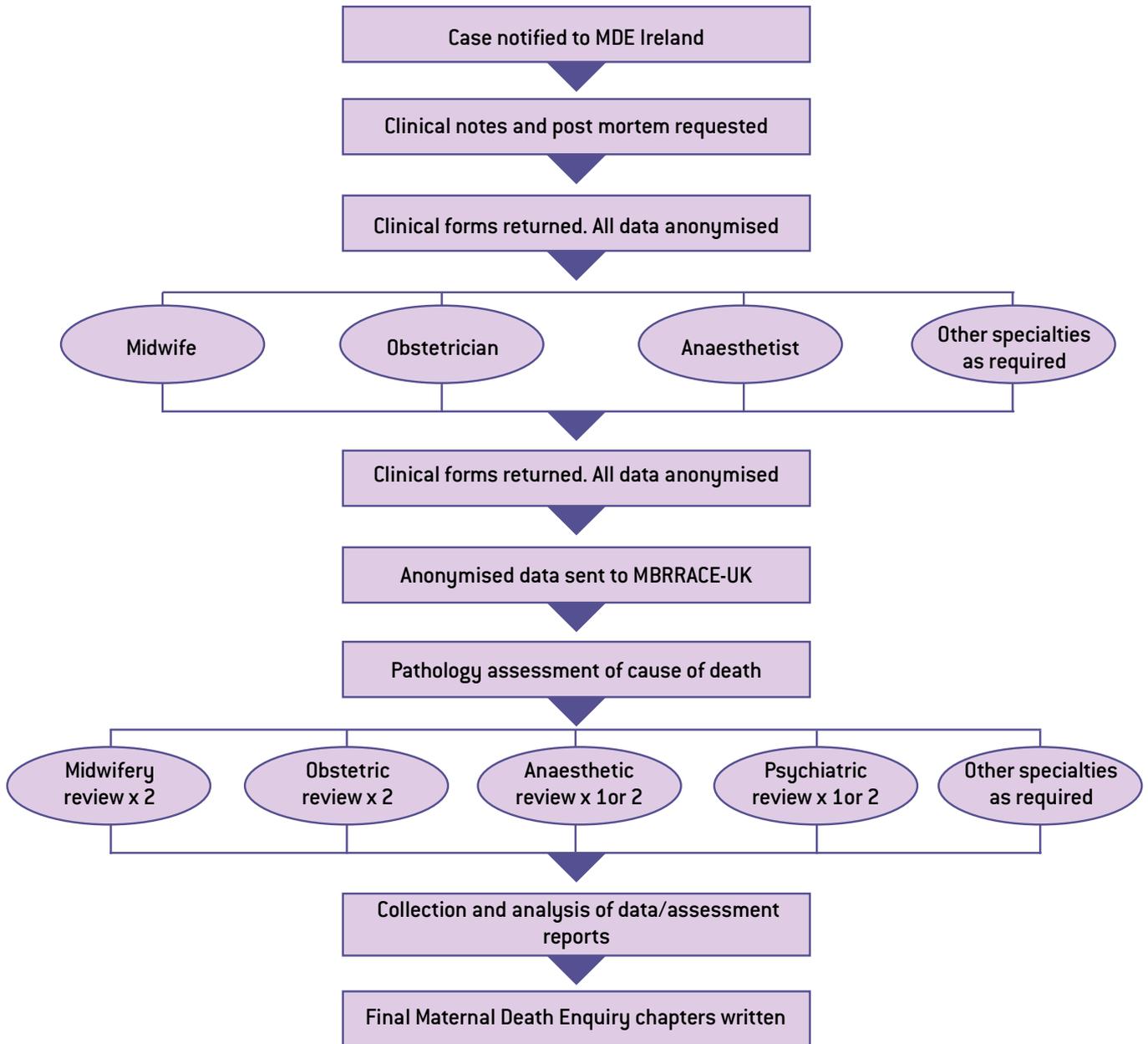
9 Central Statistics Office. [2017] Vital Statistics Annual Report 2015. Cork. Available at: <http://www.cso.ie/en/releasesandpublications/ep/pvsar/vitalstatisticsannualreport2015/infantmortalitystillbirthsandmaternalmortality2015/>

10 EURO-PERISTAT Project with SCPE and EUROCAT. European Perinatal Health Report. The health and care of pregnant women and babies in Europe in 2010. May 2013. Available at www.europeristat.com

11 Hogan M, Foreman K, Naghavi M, Ahn S, Wang M, Makela S, Lopez AD, Lozano R, Murray CJ. Maternal mortality for 181 countries, 1980-2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet*. 2010; 6736(10):1-15

Data collection and assessment processes: MDE Ireland and MBRRACE-UK

Figure 1: Data collection and assessment processes: MDE Ireland and MBRRACE-UK



Expert review

Multidisciplinary assessors are clinicians who work independently of the confidential enquiry into maternal deaths but contribute to the enquiry process in both Ireland and the UK. In Ireland, assessors have been nominated by the relevant professional bodies and bring a wide range of clinical expertise and experience to the enquiry from the following disciplines: Obstetrics, Midwifery, Anaesthesia, Perinatal

Pathology and Perinatal Psychiatry (Appendix 1). The role of assessors is to identify quality of care given according to criteria set by MBRRACE-UK as detailed in Box 1.¹² All assessors have undergone training and are provided with guidance detailing standards of care against which deaths are assessed. The assessment process and its findings are strictly confidential and all assessors are required to sign a confidentiality agreement.

Box 1

Assessment of Quality of Care

- Good care; no improvements identified
- Improvements in care* identified which would have made no difference to the outcome
- Improvements in care* identified which may have made a difference to the outcome

*Improvements in care are interpreted to include adherence to guidelines, where these exist and have not been followed, as well as other improvements which would normally be considered part of good care, where no formal guidelines exist.

¹² Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–12. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2014.

Maternal Mortality in Ireland 2013-2015:

Main findings

For the years 2013 – 2015, a total of 15 maternal deaths, occurring during or within 42 days of the pregnancy end, were identified by MDE Ireland. Of these 15 deaths, 4 were classified as direct, 9 as indirect, and the remaining 2 were attributed to coincidental causes.

During the triennium, there were seven further late maternal deaths i.e. deaths due to direct or indirect causes occurring between 42 days and one year following pregnancy.

There was no evidence of clustering in any one maternity hospital.

Causes of Maternal Deaths in Ireland 2013-2015

Direct

The four maternal deaths in 2013-2015 due to direct causes were attributed to:

- Thromboembolism (1)
- Pre-Eclampsia/Eclampsia (1)
- Amniotic Fluid Embolism (1)
- Early Pregnancy Complication (1).

Indirect

The nine maternal deaths in 2013-2015 due to indirect causes were attributed to Cardiac Disease (6) thus:

- myocardial infarction associated with coronary artery dissection (3)
 - myocardial infarction (1)
 - cardiac arrest due to hyperkalaemia (1)
 - sudden arrhythmic death syndrome (1)
- and Neurological Conditions (3).

In common with UK experience, cardiac disease is the leading cause of indirect maternal death in Ireland.

The proportion of causes of death due to direct and indirect causes was 30% and 70% respectively for 2013-2015. This reflects recent findings in the UK.

Coincidental

Two maternal deaths in 2013-2015 were attributed to coincidental causes. Both deaths were due to malignancy.

Late

Seven late maternal deaths were reported in 2013-2015. Of these, five were attributed to direct causes - suicide (4), thromboembolism (1) - and two were attributed to indirect causes - an indirect neurological condition (1), and an indirect drug related psychiatric cause (1). An additional two coincidental late deaths were attributed to malignant disease.

Thus, as in the UK, maternal suicide is the leading cause of direct maternal deaths occurring between six weeks and one year after pregnancy end.

Confidential enquiry findings into the care of women who died from sepsis, haemorrhage, amniotic fluid embolism, anaesthetic related causes, neurological and other indirect causes in the UK and the Ireland are described in detail in the MBRRACE-UK 2017 report.¹³

¹³ Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013–15. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2017.

Maternal Mortality Rate 2013-2015

For the triennium 2013-2015 there were 13 direct or indirect maternal deaths among 198,914 maternities in Ireland. This gave a MMR of 6.5 per 100,000 maternities (95% CI 3.5-11.2). Taking account of the relatively small number of maternal deaths in Ireland,

marked fluctuation in MMR is inevitable and must be interpreted with caution. The apparent improvement in MMR when compared with previous Irish data from 2009 is not statistically significant.

Comparison of Maternal Mortality Rates: Ireland and the UK 2013–2015

For the triennium 2013 – 2015, the Irish MMR was 6.5 per 100,000 maternities (95% CI 3.5-11.2) and the UK MMR was 8.76 per 100,000 maternities (95% CI 7.59-10.05). This does not

represent a statistically significant difference in MMR between countries (Risk ratio 0.75, CI 0.43-1.31; $p = 0.306$).

Maternal Mortality in Ireland 2009-2015

For the years 2009 – 2015, a total of 53 maternal deaths occurring during or within 42 days of the pregnancy end were identified by MDE Ireland. There were 491,759 maternities in Ireland during these seven reporting years. Of these 53 deaths, 19 were classified as direct maternal deaths, 25 as indirect maternal deaths, and the remaining 9 were attributed to coincidental causes.

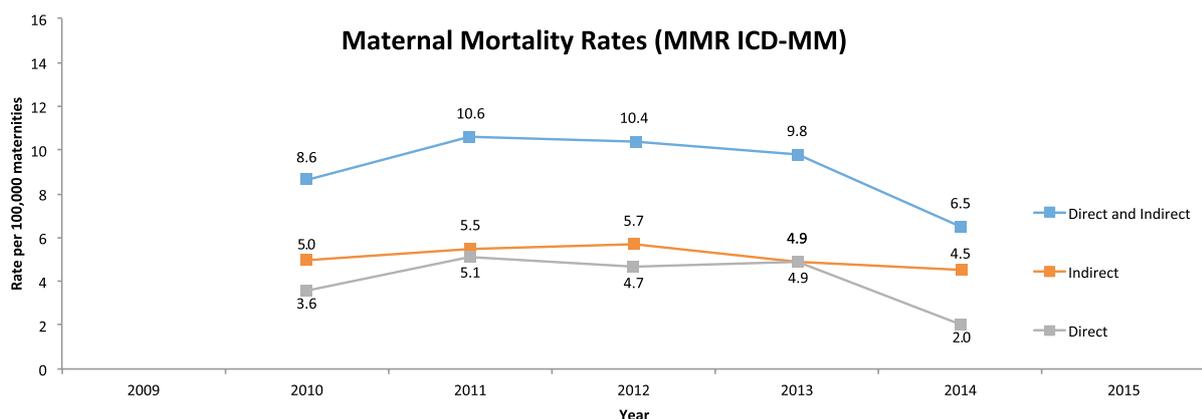
Table 3 demonstrates a rolling three-yearly MMR since the inception of MDE Ireland in 2009 using ICD-MM classification on cause of death. Rates are plotted in the middle year of the triennium in Figure 2.

Changes in the MMR over the seven year period 2009-2015 were not statistically significant

Table 3: Direct and Indirect Maternal Mortality rates per 100,000 maternities in Ireland using ICD-MM classification on cause of death: rolling three year data 2009-2015

Triennium	Total Irish Maternities*	Direct Maternal Deaths		Indirect Maternal Deaths		Total Maternal Deaths	
		n	Rate [95%CI]	n	Rate [95%CI]	n	Rate [95%CI]
2009-2011	222,136	8	3.6 (1.6-7.1)	11	5.0 (2.5-8.9)	19	8.6 (5.2-13.4)
2010-2012	218,035	11	5.1 (2.5-9.0)	12	5.5 (2.8-9.6)	23	10.6 (6.7-15.8)
2011-2013	211,669	10	4.7 (2.3-8.7)	12	5.7 (2.9-9.9)	22	10.4 (6.5-15.7)
2012-2014	204,999	10	4.9 (2.3-9.0)	10	4.9 (2.3-9.0)	20	9.8 (6.0-15.1)
2013-2015	198,914	4	2.0 (0.5-5.2)	9	4.5 (2.1-8.6)	13	6.5 (3.5-11.2)

*Source: Healthcare Pricing Office. Perinatal Statistics Reports 2009-2015. Dublin: Health Service Executive

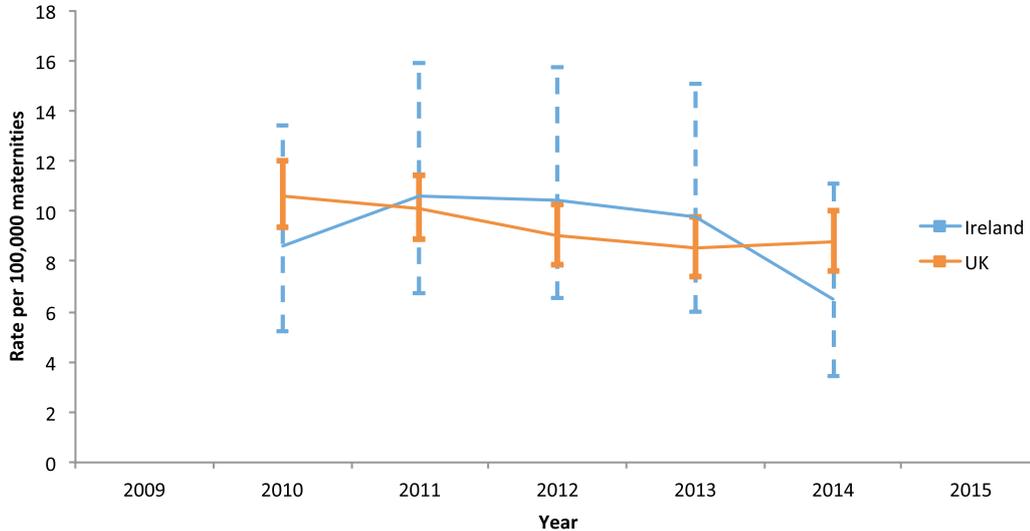


Note: Three-year moving average rates are plotted in middle year of triennium

Figure 2: Direct and Indirect Maternal Mortality rates per 100,000 maternities in Ireland using ICD-MM classification on cause of death: rolling three year data 2009 – 2015

Comparison of Maternal Mortality Rates: Ireland and the UK 2009 –2015

Figure 3 illustrates rolling three-yearly average MMR for Ireland and the UK over the seven years 2009-2015. There has been no statistically significant difference in rates between the two jurisdictions.



Note: Three-year moving average rates are plotted in middle year of triennium

Figure 3: Maternal Mortality rates per 100,000 maternities: Ireland and the UK 2009- 2015.

Causes of Maternal Deaths in Ireland 2009-2015

Based on the ICD-MM (WHO, 2012) classification, the proportion of direct and indirect maternal deaths was 43% and 57% respectively for the reporting years 2009-2015. This reflects recent findings in the UK.

Direct and Indirect maternal deaths by cause are detailed in Tables 4 and 5. To facilitate international comparisons and comparison with UK CEMD reports, causes of maternal deaths are categorised and presented using the UK convention in Table 4 and the ICD-MM classification in Table 5. On account of the small number of cases per category in Ireland and the limited power of analysis in a small cohort, rates per category are not appropriate and have not been calculated.

As in the UK, cardiac disease was the single commonest cause of maternal death in Ireland 2009-2015, accounting for 31.8 per cent of all direct and indirect deaths. The 14 deaths were attributed to:

- Coronary artery dissection (4)
- Sudden adult death syndrome (4)
- Dissection of aorta (2)
- Myocardial infarction (1)
- Peripartum cardiomyopathy (1)
- Hyperkalaemia (1)
- Aortic thrombus with multiple infarcts (1)

Venous thromboembolism and suicide continue to feature prominently as leading causes of direct maternal death. In addition, suicide was the commonest cause of late maternal death in 2013-2015.

Table 4: Causes of direct and indirect maternal deaths: Ireland 2009-2015

Cause of Maternal Death	2009- 2011	2012-2014	2013- 2015	2009-2015
Direct Maternal Deaths	8	10	4	19
Thrombosis and thromboembolism	3	2	1	5
Pre-eclampsia and eclampsia	1	1	1	2
Genital Tract Sepsis*	-	1	-	1
Amniotic fluid embolism	1	2	1	3
Early pregnancy deaths	-	-	1	1
Haemorrhage	1	1	-	2
Anaesthesia	-	-	-	-
Psychiatric causes-suicides	2	3	-	5
Indirect Maternal Deaths	11	10	9	25
Cardiac Disease	4	7	6	14
Other Indirect causes [†]	4	1	-	5
Indirect neurological conditions**	3	2	3	6
Coincidental Maternal Deaths	6	2	2	9

*Genital tract sepsis deaths only, including early pregnancy deaths as the result of genital tract sepsis. Other deaths from infectious causes are classified under other indirect causes

[†]Includes 2 deaths attributed to H1N1 influenza

**Includes 2 cases of Epilepsy related mortality

Table 5: Cause of direct and indirect maternal deaths using ICD-MM classification, per 100,000 maternities: Ireland 2009-2015

Cause of Maternal Death	2009- 2011	2012-2014	2013- 2015	2009-2015
Direct Maternal Deaths	8	10	4	19
Group 1: Pregnancy with abortive outcome	0	0	1	1
Group 2: Hypertensive disorders	1	1	1	2
Group 3: Obstetric haemorrhage	1	1	-	2
Group 4: Pregnancy-related infection	-	1	-	1
Group 5: Other obstetric complication	6	7	2	13
Group 6: Unanticipated complication of pregnancy	-	-	-	-
Indirect Maternal Deaths	11	10	9	25
Group 7: Non obstetric complications	11	10	9	25
Group 8: Unknown/undetermined	-	-	-	-
Group 9: Coincidental Maternal Deaths	6	2	2	9

Characteristics of women who died from direct and indirect causes: Ireland 2009-2015

Mothers and babies

One third (n=15; 34 per cent) of the 44 women who died from direct and indirect causes in Ireland 2009-2015 were still pregnant at the time of death (Table 6). This is higher than a rate of 25 per cent reported in the UK for the triennium 2013-2015.¹⁴ Of the remaining 29 women, 25 women gave birth to 27 babies.

Of these 27, there were 2 stillbirths and 25 livebirths, two of which resulted in early neonatal death. The remaining four women died before fetal viability, 3 associated with miscarriage and 1 associated with ruptured ectopic pregnancy.

Table 6: Timing of direct and indirect maternal deaths in relation to pregnancy 2009-2015

Timing of maternal death in relation to pregnancy	Direct Maternal Deaths (n=19)	Indirect Maternal Deaths (n=25)	Total Maternal Deaths (n=44)
Antenatal period < 20 weeks	3	5	8
Antenatal period ≥ 20 weeks	2	5	7
Peripartum or on day of delivery	8	6	14
Postnatal day 1 to 42 days	6	9	15

The majority of these women were delivered by caesarean section (n=20; 69%) of which 7 were reported as perimortem caesarean sections. Five perimortem caesarean sections were performed at ≥ 37 weeks gestation, delivering 1 stillbirth and 4 live births, 1 of which resulted in early

neonatal death. A further 2 perimortem caesarean sections were carried out at ≤ 32 weeks gestation. The outcome of these deliveries was one early neonatal death and one intrauterine death diagnosed prior to delivery.

Location of death in women who died from direct and indirect causes: Ireland 2009-2015

The majority of women (n=11; 58 per cent) whose causes of death were classified as direct died in an Intensive Care Unit (ICU). A further four direct maternal deaths occurred outside the hospital setting; all were attributed to suicide. In contrast, indirect maternal deaths occurred in a variety of settings (see Table 7).

With regard to pregnant and recently pregnant women, this highlights the importance of communication between health professionals across a range of healthcare services and the importance of awareness of Irish national guidelines for critically ill women in obstetrics published in 2014.¹⁵

14 Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ (Eds.) on behalf of MBRACE-UK. Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013-15. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2017.

15 Clinical Practice Guideline No 30 (2014). Guideline for the Critically ill Woman in Obstetrics : Institute of Obstetricians and Gynaecologists / Health Service Executive

Table 7: Location of direct and indirect maternal death 2009 – 2015

Location of death	Direct Maternal Deaths (n=19)	Indirect Maternal Deaths (n=25)	Total Maternal Deaths (n=44)
Home / outwith hospital setting	4*	5	9
Hospital (except A&E and ICU)	3	3	6
A&E	1	8	9
ICU	11	9	20

*All 4 cases were classified as direct due to suicide

Ethnicity/ Nationality

Of the 44 deaths of women from direct and indirect causes in 2009-2015, 32 % occurred in women born outside of Ireland, who represented 23.4 % of all maternities in Ireland

for that time period. While such a finding suggests over-representation in Irish maternal deaths, it was not statistically significant (Rate Ratio 1.55 CI 0.87-2.76, $p = 0.137$)

Maternal Age

While the number of maternal deaths is small in specific age groups, for the age range 20-39 years, the mortality rate increased with advancing maternal age (relative risk=1.16,

95% CI=1.13-2.30, $p = 0.008$). There was an almost fourfold increased risk among 35-39 year-olds compared to 20-24 year-olds (Table 8). This reflects findings reported in the UK.

Table 8: Age distribution of women who died from direct and indirect causes in Ireland 2009 – 2015

Maternal Age	Direct (n=19)	Indirect (n=25)	Total Maternal Deaths (n=44)	Total Maternities*	Mortality Rate** (95%CI)	Relative risk (95%CI)
<20	0	0	0	11,385	-	-
20-24	1	1	2	49,098	4.1 (0.5-14.7)	1.00 (Ref.)
25-29	3	3	6	106,531	5.6 (2.1-12.3)	1.38 (0.28-6.85)
30-34	10	7	17	175,613	9.7 (5.6-15.5)	2.38 (0.55-10.29)
35-39	5	14	19	122,490	15.5 (9.3-24.2)	3.81 (0.89-16.35)
40+	0	0	0	26,587	-	-

*Maternities by maternal age groups¹⁶

**Maternal Mortality Rate per 100,000 maternities MR

Parity

Table 9 details the distribution of maternal deaths by parity. There was a suggestion of increasing MMR with increasing parity.

Notably, women of parity 2 or more had approximately three times the MMR of nulliparous women.

Table 9: Distribution of maternal deaths by parity: Ireland 2009-2015

Parity	Direct (n=19)	Indirect (n=21)	Total Maternal Deaths (n=44)	Total Maternities*	Mortality Rate (95%CI)	Relative risk (95%CI)
0	7	3	10	195,248	5.1 (2.5-9.4)	1.00 (Ref.)
1	6	8	14	167,142	8.4 (4.6-14.1)	1.64 (0.73-3.68)
2	3	11	14	84,252	16.6 (9.1-27.9)	3.24 (1.44-7.3)
≥3	3	3	6	45,083	13.3 (4.9-29.0)	2.60 (0.94-7.15)

*Parity not stated for 34 maternities

Body mass index (BMI)

There is evidence that increased maternal BMI is associated with higher risk of maternal death due to specific pregnancy complications. National guidelines recommend the recording of BMI in the maternity notes.¹⁷ While this may be common practice, there are no national data on the BMI of the pregnant population

available in Ireland. Table 10 demonstrates the distribution of BMI among women who died.

Overall, the distribution of maternal deaths in Ireland does not suggest an association with increased BMI, but this observation may be a reflection of small cohort size.

Table 10: Body Mass Index of women who died: Ireland 2009 – 2015

BMI Category (Kg.m-2)	Direct (n=19)	Indirect (n=25)	Total Maternal Deaths n=44 (%)*	Healthy Ireland Survey 2015 (%)
Underweight (<18.5)	-	-	-	3%
Healthy (18.5-24.9)	10	10	20 (54%)	44%
Overweight (25.0-29.9)	3	7	10 (27%)	31%
Obese (≥ 30.0)	2	5	7 (19%)	22%
Data Missing	4	3	7	-

*Percentages based on the 37 maternal death cases where data on BMI was known.

Smoking

Data on smoking status was unknown in seven cases of direct and indirect maternal deaths 2009 – 2015. Of the 37 women whose smoking status was recorded, over one in four smoked (n=11:29.7%). There are no national

data on the prevalence of smoking during pregnancy in Ireland but rates of 12%, 15%, 16% and 19% have been reported in England, Northern Ireland, Wales and Scotland respectively.¹⁸

¹⁷ Clinical Practice Guideline No 2 (2011). Obesity and pregnancy : Institute of Obstetricians and Gynaecologists / Health Service Executive

¹⁸ EURO-PERISTAT Project with SCPE and EUROCAT. European Perinatal Health Report. The health and care of pregnant women and babies in Europe in 2010. May 2013. Available www.europeristat.com

Specific lessons learned in the Irish context 2009-2015

- Cardiac disease was the largest single cause of all maternal deaths for the years 2009 – 2015, and the triennium 2013-2015 in Ireland.
- The significantly higher rate of indirect compared with direct maternal deaths highlights ongoing challenges for maternity services in caring for women with pre-existing medical and mental health disorders.
- Suicide is now classified as a direct maternal death, of which it is a leading cause. Further, it is the leading cause of late maternal death in Ireland, reflecting experience in the UK.
- Thromboembolism remains a leading cause of direct maternal death in Ireland.
- The further evidence of increased maternal mortality in association with increasing maternal age is of concern, taking account of the current trend in Ireland towards increasing age of women in pregnancy and childbirth.

Appendix 1: Irish assessors for the confidential maternal death enquiry in Ireland and the UK

Obstetric Assessors:

Colm O’Herlihy, Consultant Obstetrician, Professor of Obstetrics and Gynaecology in UCD School of Medicine and Medical Science (until 2016)

Peter McParland, Consultant Obstetrician and Gynaecologist, National Maternity Hospital, Dublin (from 2016)

Pathology Assessor:

Peter Kelehan, Consultant Perinatal and Gynaecological Pathologist

Anaesthetic Assessor:

John Loughrey, Consultant Anaesthetist, Rotunda Hospital, Dublin

Psychiatric Assessors:

Anthony McCarthy, Consultant Perinatal Psychiatrist, National Maternity Hospital and St Vincent’s University Hospital, Dublin

Joanne Fenton, Consultant Perinatal Psychiatrist, Coombe Women and Infants University Hospital, Dublin (from 2015)

Midwifery Assessors:

Siobhan Canny, Director of Midwifery, Portiuncula University Hospital, Ballinasloe, Co. Galway

Mary Doyle, Assistant Director of Midwifery, Midwifery Practice Development Coordinator, University Maternity Hospital, Limerick

Fiona Hanrahan, Assistant Director of Midwifery and Nursing, Rotunda Hospital, Dublin

Appendix 2: Membership of the Working Group on Maternal Mortality in Ireland

Michael F O'Hare, Consultant Obstetrician & Gynaecologist (Chairman)

Colm O'Herlihy, Consultant Obstetrician, Professor of Obstetrics and Gynaecology in UCD School of Medicine and Medical Science

Richard Greene, Consultant Obstetrician, Professor of Clinical Obstetrics in UCC and Director of the National Perinatal Epidemiology Centre, Cork

John Loughrey, Consultant Anesthetist, Rotunda Hospital, Dublin

Karen Robinson, Doctor, Clinical Risk Advisor, Clinical Indemnity Scheme, States Claims Agency, Dublin

Deirdre Daly, Assistant Professor in Midwifery, Trinity College Dublin

Ursula Byrne, Acting Director of Regulation, Nursing and Midwifery Board of Ireland (until 2015)

Bernie Conolly, Professional Advisor, Nursing and Midwifery Board of Ireland (from 2015)

Fionnuala Cooney, Specialist in Public Health Medicine, Health Service Executive (HSE) East

Helen Byrne, Quality and Patient Safety Directorate, HSE (until 2015)

Jennifer Martin, National Lead for information and analysis, Quality and Patient Safety Directorate, HSE

Sheila Sugrue, National Lead Midwife, Office of Nursing and Midwifery Services Directorate

Edel Manning, Coordinator, Maternal Death Enquiry, Ireland

Appendix 3: Members of the Oxford based MBRRACE-UK team:

Jenny Kurinczuk, Professor of Perinatal Epidemiology, Director, National Perinatal Epidemiology Unit, Lead MBRRACE-UK, University of Oxford

Marian Knight, Professor of Maternal and Child Population Health, NIHR Research Professor and Honorary Consultant in Public Health, Maternal Programme Lead for MBRRACE-UK, University of Oxford

Brenda Strohm, Acting Programme Manager

Rachel Smith, Programme Manager

Peter Smith, Programmer

Thomas Boby, Senior Programmer

Xuejuan Fan, Database Manager

Oliver Shaw, Administrator

Jane Forrester-Barker, Data Coordinator

Dagmar Hutt, Interim Events Coordinator

Kate De Blanger, Events Coordinator

Manisha Nair, NPEU Senior Epidemiologist

Other support staff who assisted on a temporary basis:

Emma Boby

Jennifer Duffin

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