Maternal Outcomes of Premature Rupture of Membrane and Associated Factors in East Gojjam Zone Public Hospitals, North West, Ethiopia, 2022

Fekadu Baye*, **Kumlachew Solomon, Getachew Tilaye, Habtamu Ayele, Geremew Bishaw and Melaku Laikemariam**

Department of Midwifery, College of Health Medicine and Science, Debre Markos University, Ethiopia

***Corresponding author**

Fekadu Baye, Department of Midwifery, College of Health Medicine and Science, Debre Markos University, Ethiopia.

ABSTRACT

Introduction: Premature rupture of the membranes is rupture of fetal membranes at least one hour before the onset of labor. The burden of this problem ranges from maternal mortality and morbidity to national economic loss due to drug expenses and expenses on work load to the health professionals. Though studies were conducted on maternal outcomes of premature rupture of membrane in Ethiopia, there is a lack of information on its facilitating factors for each maternal outcome in the study area.

Method: A cross-sectional study was conducted among 218 pregnant mothers diagnosed with premature rupture of membrane from May 18-2022 to June 18-2022. A systematic random sampling method was employed to select the study participant. Data was collected from the mother's clinical record. A standardized data collection checklist was used to extract the data from the participants' charts. Data was entered to Epi-data 4.2 and exported to SPSS 25 for analysis. Independent variables with p-value of < 0.05 in the multivariable analysis were considered as statistically significantly associated with the outcome variable, and its strength of association was measured using AOR.

Results: In this study the proportion of unfavorable maternal outcome of PROM was (56) 25.7% [95% CI: 20, 32%]. Being rural resident (AOR 2.98, 95% CI: 1.367, 6.483) and advanced maternal age more than 36 years old (AOR = 2.44, 95% CI: 1.121, 5.313) were significantly associated factors with unfavorable maternal outcomes of premature rupture of membrane.

Conclusion: Premature rupture of membrane in East Gojjam Zone Public hospitals has a huge unfavorable maternal outcome. It is associated with rural residence and advanced maternal age. Hospital administrative bodies and professionals are advised to give special attention to rural mothers to safeguard this problem.

Keywords: Premature Rupture of Membrane, Maternal Outcome, East Gojjam Zone, Public Hospitals, Northwest Ethiopia

Abbreviations

ANC : Antenatal Care

AOR : Adjusted Odds Ratio

APGAR : Confidence Interval

C/S : Caesarean Section

EGZPH : East Gojjam Zone Public Hospital

GA : Gestational age

MSC : Master of Science

OR : Odds Ratio

PPROM : Preterm Premature rupture of membrane

PROM : Premature rupture of membrane

SPSS : Statistical Package for Social Science

Introduction
Premature rupture of the membranes (PROM) is a leakage of amniotic fluid at any time at least one hour before the onset of labor. This definition has been subcategorized into preterm PROM when the gestational age is less than 37 weeks and term PROM when the gestational age is greater than or equal to 37 weeks [1]. The term latency period is the time interval from rupture of the membrane until the occurrence of true labor, whereas prolonged PROM is the term that is used when the time is prolonged >12 hours of duration, which has an inverse relation with favorable outcomes of PROM [2-4].

A significant maternal mortality and morbidities following PROM are linked and shown to be the cause of 18%–20% and 21.4% of prenatal mortalities and morbidity respectively [5]. The burden of PROM which ranges from maternal, fetal, and neonatal mortality and morbidity to national economic loss due to drug expense, hospitalization, absence from the workplace, and expense to the health professionals which results, in maternal, infant, and neonatal risks [6,7].

PROM complicates 5% to 10% of pregnancies which is associated with significant maternal and fetal morbidity and mortality [8]. Intra amniotic infection following PROM is the most common complication among maternal complications [6,9]. Maternal complications include chorioamnionitis, which occurs in 13%–60% of women with the presence of PROM, abruption placenta, and postpartum endometrial infections [10] Following premature rupture of membrane, the estimated contribution of sepsis to maternal mortality varies from 8 to 16%, and a systematic review revealed that maternal sepsis was the third most important cause after hemorrhage and hypertensive disorders, responsible for 11.6% of maternal deaths in Asia, 9.7% in Africa and 7.7% in Latin America and Caribbean [1].

The attributable factor for the occurrence of complications of PROM is increased if the mother has previous PROM, low body mass index, infection, and longer time elapsed between the rupture and delivery, lately administration of prophylactic antibiotics [11].

Early Diagnosis, proper management, knowing the possible factors for each maternal outcomes of PROM, and timely initiation of antibiotics are very crucial to limiting various maternal complications; early presentation to the hospital and interventions improves maternal outcomes of patients with PROM [12]. However, in middle and lower-income countries like Ethiopia where health facilities are not well organized with necessary skilled health professionals, a large number of mothers come to the facilities too late due to inaccessibility of infrastructures which leads to significant unfavorable outcomes or complications. In most cases, the diagnostics do not cause bigger problems, but in some situations, it may not be easy to make the right diagnosis for the right patient [13].

The morbidity and mortality, as well as other complications related to PROM, can be decreased if closely or vigilant monitoring of the antenatal, labor and careful decisions by addressing other important variables like provision of antibiotics, utilization of PROM chart and timely initiating of antibiotics.

Maternal mortality such as hospitalization, financial misfortune, in case of medicating costs and treatment, and the workload of the well-being specialists all these are the inclusive burden of premature rupture of the membrane when it starts early [7].

Maternal health is a useful indicator to assess the accessibility, sufficiency, and effectiveness of a country's health service system. Thus, improving maternal health and reducing child mortality by making them free of infection Sustainable Development Goals (SDGs 3) [14].

Methods
Study Setting and Design
A hospital-based cross-sectional study was conducted. The date range in which this study were conducted from May 18-2022 to June 18-2022 at East Gojjam Zone Public Hospitals. In this zone, there are 10 hospitals (one comprehensive specialized, one general, and eight primary hospitals). Those hospitals are assumed to be serving about 5 million catchment populations. The ward of those hospitals gives services of nearly 59917 per year.

Population
Source population
All pregnant mothers diagnosed with premature rupture of membrane in East Gojjam Zone Public Hospitals.

Study Population
All pregnant mothers diagnosed with premature rupture of membrane from May 18 to June 18, 2022 in East Gojjam Zone Public Hospitals

Inclusion criteria: All randomly selected records of pregnant mothers diagnosed with premature rupture of membrane who were admitted and gave birth from May, 18 to June 18, 2022 in East Gojjam Zone Public Hospitals

Exclusion criteria: pregnant mothers with Incomplete data, referred case records, mothers were admitted and managed as PROM and returned to home before delivery but did not gave birth at that hospital, twin pregnancy, any co-morbidity like a hypertensive disorder of pregnancy, DM, cardiac disease, etc. were excluded.

Sample Size Determination
The sample size was determined using single population proportion formula by assuming proportion 22.2% [15], 95% confidence level and estimated margin of error 5% by adding lost cards or an incomplete data rate (missing variables) of 10% which is 20 on 198 making the final sample size 218.

Sampling Procedure and Techniques
To get study records, first, the average number of PROM cases among mothers who gave birth in these hospitals before the data collection period was estimated based on the previous one-year records. The total number of women in the registration book who were managed as PROM and gave birth in East Gojjam Zone Public Hospitals in the last 1 year was (859) sourced from each hospital's PROM case counting in the last 1 year's registration book. Proportional allocation based on a woman diagnosed with PROM to each hospital and card register identification number.
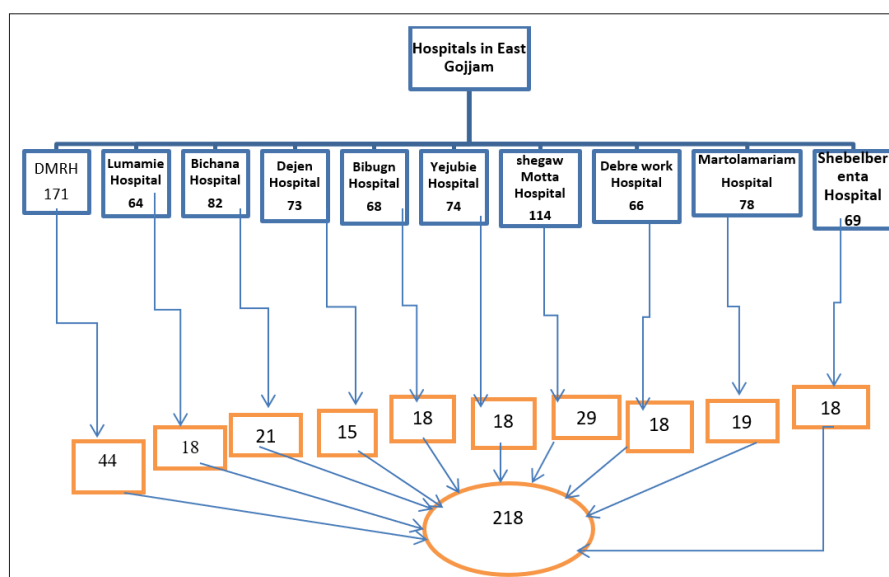
Figure 1: Schematic presentation of sampling procedure with proportional allocation to assess outcomes of PROM & its associated factors in East Gojjam Zone Public Hospitals, Northwest Ethiopia, 2022.

NB: DMCSH= Debre Markos comprehensive specialized Hospital

Variables
Dependent Variable:
The dependent variable is maternal outcome of PROM

Independent Variables
There are three groups of independent variables in the study. These are:
Socio-Demographic Factors (Residence, Marital status, Age)
Service-Related Factors (Time of initiation of antibiotics, Provision of antibiotics, Duration of hospital stay, utilization of PROM charts, ANC follow up, Number of ANC follow up)
Obstetric Related Factors (Gravidity, Gestational age, Parity, latency period, Duration of PROM until admission, previous history of PROM

Operational Definitions
A Maternal Complication of PROM: complications of the mother following PROM including infection (chorioamnionitis, puerperal sepsis), oligohydramnios, abruption placenta, postpartum hemorrhage, and death related to the above complications [16-18].

Favorable Maternal Outcome: Mothers following PROM ends up without any complication and/or maternal death [15,16,18].
Unfavorable Maternal Outcome- Mother alive with complication and/or maternal death [15,16,18].
Incomplete Chart Record- charts with incomplete data records like the above-listed outcomes variables (complications of PROM) and/or other important determinant variables were missed; i.e residence, patient history note and gestational age.

Data Collection Procedures
This study did not involve human participants, since data was collected from a chart (mother's clinical record) including an operation note review using a pre-tested structured questionnaire. The questionnaire was adapted from previous similar literature [15,16,18], after considering the local situation variables that are listed in different literature used to develop the questionnaire. The questionnaire was developed in English. The English version questionnaire was used for data collection because all data collectors can understand it easily. The questionnaire had 4 parts Mother's socio-demographic variables, obstetric variables, outcomes of PROM, and service-related variables. The data was collected by 5 Bsc midwife data collectors from newly graduated midwives with 2 Msc midwife supervisors from the academic area. Supervisors and the principal investigator also followed the overall activities daily.

Data Quality Control Issues
To assure the data quality high emphasis was given to designing data collection instruments. Before starting the actual survey, the questionnaire was pre-tested to check its completeness and any missed variables on 5% of the sample size at Debremarkos Comprehensive Specialized Hospitals. supervisors and collectors were employed and trained for one day about the time of data collection, timely collection and reorganization of the collected data, and submission on due time. Cronbach's alpha coefficient was used to know the internal consistency of the questionnaire and it was 0.806.

Throughout the data collection, regular meetings were held between the data collectors and the principal investigator together in which problematic issues arising from data collectors were conducted decisions were reached. The collected data were reviewed and checked for completeness before data entry. Daily communication was conducted among data collectors, supervisors, and the principal investigator for discussion regarding the presenting difficulties and to assess the progress of data collection.

Data Management and Analysis
The data were checked for completeness, coded, entered, and cleaned using Epi-data version 4.4.2.1 and then exported to Statistical Package for Social Science (SPSS) Version-25 computer software for management and analysis. Both

descriptive statistics and regression analyses were computed. Multicollinearity was checked to see the linear correlation among the associated independent variables by using the variance inflation factor (VIF) i.e. (0.682-0.959). Therefore, there was no correlation between independent variables.

Descriptive statistical analysis such as cross tabulation, simple frequencies, measures of central tendencies, and measures of variations was computed according to the data distribution to summarize and describe the characteristics of study participants, and the information was presented using frequencies, summary measures, and tables.

In Bivariable analysis, crude odds ratio with 95% CI, was used to see the association between each independent variable and dependent variable by using bivariable regression analysis. The result was presented as crude odds ratio (COR) to show the strength of association between independent variables and dependent variables. Independent variables with a significance level of p-value <0.25 at 95% CI in bivariable analysis and which was fit for the model of regression were retained for inclusion in the multiple regression model to control all possible confounders.

In Multivariable analysis, multiple logistic regression models using the backward linear regression method were used to control the confounders. Hosmer-Lemeshow's goodness-of-fit test was done to check for model fitness. The Hosmer-Lemeshow test was found (p-value, 0.681) which indicates the model was fitted. Adjusted odds ratio (AOR) with 95% CI was estimated to show the strength of association between the independent variables and the dependent variable after controlling the effects of confounders. Independent variables with P-value < 0.05 and which do not include the null value in the 95% confidence interval were declared as having a statistically significant association with the outcome variable.

Ethical Considerations
Ethical clearances to conduct this study were attained by a letter of permission, which was obtained from Debre Markos University, college of health science institutional review committee with its reference number (HSC/R/C/Ser/PG/Co/173/11/14) and were submitted to each East Gojjam zone public hospital medical director's office and each hospital administrative. A written permission letter was also received from each Hospital manager and secured after a detailed explanation of the nature and main purpose of the study. Again, before the data collection, verbal informed consent was obtained from the documentation room (card room workers), each hospital administrative directors and personal identifiers were not used during and after data collection

Result
Socio-Demographic Characteristics of Mothers
A total of 218 cases were included in the analysis. The median age of the mothers was 32 years (SD± 5.831 years). Most of the mothers, 206 (94.5 %) were married. More than half of the mothers, 141 (64.7%) were rural dwellers.

Table 1: Socio-demographic characteristics among mothers recorded with PROM, in East Gojjam Zone Public Hospitals, North West Ethiopia, 2022(n=218)

Variables	Frequency	Percentage
Maternal age		
Age18-35	168	77.1
Age ≥36	50	22.9
Marital Status		
Married	206	94.5
Separated	6	2.7
Divorced	6	2.8
Residence		
Rural	141	64.7
Urban	77	35.3

Obstetric and service-related characteristics
About half of the mothers, 109 (50%) were multiparas, 42(19.3%) mothers were primigravida and 43(19.7%) mothers had a history of PROM. The median gestational age of the mothers was 37 weeks with (SD±2.775). More than half of the mothers, 146 (67%) were found gestational ages of 37-42 weeks.

Among 218 mothers, 209(95.9%) mothers had ANC follow-ups from those 115(55.8%) had greater than or equal to 4 ANC follow-ups. More than half (165 (75.7%)) of the mother's onset of labor were spontaneous and 163(74.8%) were delivered vaginally and 46(21.1%) were delivered by c/section.

Table 2: Obstetric and Service-Related Characteristics Among Mothers Recorded with Prom, In East Gojjam Zone Public Hospitals, North West Ethiopia from 2022 (n=218)

Obstetrics and service-related variables	Frequency	Percentage
Parity		
Primipara	109	50
Multipara	109	50
Gestational age at admission in weeks		
<=34 GA	36	16.5
35-36 GA	36	16.5
37-42 GA	146	67
Duration of PROM to the onset of labor		
<24 hr.	109	50
>=24 hr.	109	50
Duration of PROM until admission		
<12 hr.	138	63.3
>=12 hr.	80	36.7
Presence of chorioamnionitis		
Yes	22	10.1
No	196	89.9
Mode of delivery		

Normal SVD	163	74.8
Instrumental delivery	9	4.2
C/Section	46	21.1
Onset of labor		
Spontaneous	165	75.7
Induced	53	24.3
If the mode of delivery was C/S what was the Indication of c/section		
Failed induction/augmentation	12	26.5
NRFHRP	25	53.1
Malpresentation and position	9	20.4
Previous history of PROM		
Yes	43	19.7
No	175	80.3
ANC follow up		
Yes	209	95.9
No	9	4.1
If YES, how many ANC follow up		
1 visit	4	2
2-3 visit	87	42.2
>=4 visit	115	55.8

Table 3: Obstetric and Service-Related Characteristics Among Mothers Record with Prom, In East Gojjam Zone Public Hospitals, North West Ethiopia 2022 (n=218)

Obstetrics and service-related variables	Frequency	Percentage
Duration of hospital stay		
<3 days	82	37.6
3-7 days	74	33.9
>=8 days	62	28.5
Presence of PROM chart		
Yes	176	80.7
No	42	19.3
Antibiotic provision after rupturing of the membrane		
Yes	204	93.6
No	14	6.4
Time of Initiation of antibiotics after rupturing of the membrane		
<12 hr.	194	93.3
>=24 hr.	14	6.7

PROM; Premature Rupture of Membrane, HR; Hour, GA; Gestational Age, NRFHRP; Nonreassuring Fetal Heart Rate Pattern, C/S; Cesarean Section

Maternal Outcomes of Premature Rupture of Membrane
About 25.7% [95% CI: 20, 32%] of women showed unfavorable maternal outcomes following PROM. Of 218 mothers, 56 (25.7%) were alive with complications and 3(1.4%) of mothers died in the last year from May 18-2022 to June 18-2022. Of 218 PROM cases, 7 (3.2%) developed APH, 14(6.4%) developed oligohydramnios, 15(6.9%) had developed chorioamnionitis, 22 (10.1%) and 2 (0.9%) had developed puerperal sepsis and postpartum hemorrhage, respectively.

Table 4: Maternal Outcomes Among Mothers Recorded with Prom, In East Gojjam Zone Public Hospitals, North West, Ethiopia 2022

Unfavorable maternal outcomes of PROM		
Types of unfavorable maternal outcomes of mothers (n=56)	Frequency	Percentage
APH	7	3.2
Chorioamnionitis	15	6.9
Oligohydramnios	14	6.4
Puerperal sepsis	22	10.1
PPH	2	0.9
Maternal death	3	1.4

NB: Total percentage may be more than 100% since they are not mutually exclusive.

Factors associated with maternal outcomes of premature rupture of membrane
The associations between socio-demographic, obstetrical, and service-related factors with maternal outcomes of PROM were assessed. The variables which showed association at (0.25) level of significance in the bivariable regression analysis were maternal age, marital status, residence, parity, gestational age, duration of PROM until admission, latency period, number of ANC follow up provision of antibiotics, duration of hospital stay, utilization of PROM chart and previous history of PROM. Even though, maternal age and residence remained (P<= 0.05) significantly and independently associated with the unfavorable maternal outcomes of PROM in the multivariable regression analysis.

In multiple regressions analysis, women who come from rural areas were 3 times higher than those from urban areas to have unfavorable maternal outcomes of premature rupture of membrane (AOR = 2.98, 95% CI: 1.367, 6.483).

Advanced maternal age more than 36 years old were 2.4 times more likely to have unfavorable maternal outcomes of premature rupture of membrane than those who were less than 35 years old (AOR = 2.44, 95% CI: 1.121, 5.313).

Table 5: Bivariable and Multivariable Logistic Regression Analysis Depicting Factors Associated with Maternal Outcomes of Prom in East Gojjam Zone Public Hospitals, North West Ethiopia from (n=218)

Variables	Maternal Outcomes of PROM		COR (95% CI)	AOR (95% CI)	P value
	Unfavorable (%)	Favorable (%)			
Residence					
Rural	42(29.8)	99(70.2)	1.909(0.965, 3.777)	2.977(1.367,6.483)	0.006
Urban	14(18.2)	63(81.8)	1	1	
Maternal age					
>=36 year	17(34)	33(66)	1.704(0.858,3.384)	2.441(1.121,5.313)	0.025
<=35 year	39(23.2)	129(76.8)	1	1	
Marital status					
Unmarried	11(91.7)	1(8.3)	4.007(0.505,31.76)	10.386(1.030,104.767)	0.074
Married	151(73.3)	55(26.7)	1	1	
Parity					
Multiparity	32(29.4)	77(70.6)	1.472(0.798, 2.716)	1.747(0.821, 3.719)	0.148
Primiparity	24(22)	85(78)	1	1	
Duration of PROM until admission					
>=12 hr.	25(31.2)	55(68.8)	1.569(0.845,2.914)	1.255(0.616,2.555)	0.531
<12 hr.	31(22.5)	107(77.5)	1	1	
Provision of antibiotics					
No	4(44.4)	5(55.6)	2.415(0.625,9.333)	3.619(0.823,15.914)	0.89
Yes	52(24.9)	157(75.1)	1	1	
Duration of hospital stay					
>=4 days	35(25.7)	101(74.1)	1.006(0.537,1.885)	1.365(0.661,2.817)	0.400
<=3 days	21(25.6)	65(74.4)	1	1	
Latency period					
>=24 hr.	32(29.4)	77(70.6)	1.472(0.798,2.716)	1.821(0.918, 3.616)	0.087
<24 hr.	24(22)	85(78)	1	1	
PROM chart					
No	16(38.1)	26(61.9)	2.092(1.023, 4.280)	1.596(0.698, 3.650)	0.268
yes	40(22.7)	136(77.3)	1	1	
history of PROM					
yes	37(86)	6(14)	2.467(0.980,6.207)	2.270(0.859, 6.000)	0.000
No	125(71.4)	50(28.6)	1	1	

❖1= reference, PROM=premature rupture of membrane, *= statically significant variables

Discussion

This hospital-based cross-sectional study attempted to assess maternal outcomes of PROM and its associated factors in East Gojjam Zone Public Hospitals from May 18-2022 to June 18-2022 at East Gojjam Zone Public Hospitals.

Out of 218 total cases of PROM twenty five point seven 25.7% [95% CI: 20, 32%] had unfavorable maternal outcomes of PROM which is consistent with a cross-sectional study done in Mizan-Aman General Hospital, south-west Ethiopia (22.2%) [15]. The possible reason for this discrepancy might be a long time gap between the two studies because as the time is going on, there might be a change in policy, strategy, and improvement in health care setups due to the difference in population in which the study included socio-demographic characteristics and lifestyle activities. This can be explained due to the variation in maternal health care service utilization and antenatal care service utilization that might attribute to the difference in health-seeking behavior.

In this study, the maternal death due to PROM was 1.4% which was consistent with a study done in Addis Ababa Ethiopia (0.26%) and Mizan-Aman General Hospital (1.6%), Ethiopia [18,15]. This can be explained due to poor quality of services or poor quality of health care providers and lower-income countries like Ethiopia where health facilities are not well organized with necessary skilled health professionals, a large number of mothers come to health facilities too late due to inaccessibility of infrastructures.

The finding of this study shows that the main indications for C/Section with its percentage following PROM were non-reassuring fetal heart pattern (53.1%), the rest 46.9% were distributed to malpresentation, malposition, and failed induction, which was inconsistent or different from the result of the previous study conducted in Libya, in which the main indications for C/S were failed induction (50%), the rest 11.8% were distributed between macrosomia, previous C/S, malpresentation and malposition [19]. This might be due to differences in the management of PROM with the different management protocols and might be different sociodemographic characteristics with the accessibility and the quality of services.

Women who come from rural areas were more likely to have unfavorable maternal outcomes of PROM than women who come from urban areas; this finding is supported by the results of a study conducted in Mizan Aman, Ethiopia [15], Pakistan [20], Egypt [15] and Iran(28). This may be due to poor hygienic conditions, lack of facility and infrastructure, and poor awareness of the health care seeking behavior, thus mother whose residents was from rural areas may have an increased risk of developing complications.

In this study, advanced maternal age more than 36 years old more likely to have unfavorable maternal outcomes of premature rupture of membrane than those who were aged less than 35 years old which are supported and similar to a previous study conducted at Mizan-Aman General Hospital(26), Ethiopia, in Pakistan [20], Egypt(24) and in Iran(28).since advanced maternal age with multiparity is one of factors of PROM where women with advanced maternal age with multiparity tends to be more susceptible more to experience premature rupture of membrane.

Conclusion
Premature rupture of membrane in East Gojjam Zone Public hospitals has a huge unfavorable maternal outcome. It is associated with rural residence and advanced maternal age. Hospital administrative bodies and professionals are advised to give special attention to rural mothers to safeguard this problem.

Authors' Contributions
All the authors had significant involvement in the design of the study, data collection and analysis and preparation of the manuscript. Fekadu Baye played a pivotal role in writing the proposal and designing the study. Fekadu Baye was influential during the data collection, analysis and manuscript preparation. FB, HA, KS, ML, GB and GT are involved in the discussion as well as manuscript preparation. All authors read and permitted the final manuscript.

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