Maternal Morbidity During Pregnancy in Bangladesh: Evidence from the 2019 Bangladesh Multiple Indicator Cluster Survey

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Abstract: Maternal morbidity is a significant public health problem, particularly in developing countries, accounting three-fourth of the maternal deaths. There is dearth of information about maternal morbidity in Bangladesh. This study examined the prevalence and determinants of maternal morbidity during pregnancy in Bangladesh. Data for the study was extracted from the 2019 Bangladesh Multiple Indicator Cluster Survey (MICS), which covered a nationally representative sample of 64,378 ever-married women aged 15-49 years. For analyzing the maternal morbidity during pregnancy, a subsample of 2,722 married women who were pregnant at the time of survey was considered in this study. Descriptive and inferential statistical techniques, including multiple regression technique were used for data analysis. Negative Binomial regression model was used for investigating the determinants of morbidity, considering the number of morbidities (a count variable) as outcome variable. The results indicate that about 13% women experienced at least one of the pregnancy related morbidity, while 14% women reported that they experienced at least two morbid conditions during their last pregnancy. Overall, 1.2% of the women faced life-threating morbidity seizure or convulsion, 4.8% increased blood pressure, and 7.4% eclampsia during pregnancy. Blurred vision (12.8%) and high fever (10.2%) were the two most frequently cited maternal morbidity in Bangladesh. The findings of this study reveals multiparity (IRR=1.52, p=001), urban place of residence (IRR=1.18, p=0.047), administrative division, media exposure (IRR=1.24, p=0.004), unwanted pregnancy, migrants, and ethnic non-Bengali as the significant predictors of maternal morbidity during pregnancy in Bangladesh. The findings of this study have important implications for public health program in Bangladesh for further improvement of maternal and newborn health and survival. It is important to take adequate measure for implementing early and adequate number of antenatal care visits for early identification and treatment of pregnancy related morbidities. A greater understanding of the identified risk factors of maternal morbidity and incorporating them into short and long term health strategies would help improve the coverage and contents and thus quality of antenatal care services in Bangladesh.

Keywords: Maternal morbidity, Pregnancy complication, Multiple Indicator Survey, Bangladesh.

INTRODUCTION

Maternal morbidity, defined by the World Health Organization (WHO) as “any health condition attributed to and/or complicating pregnancy, and childbirth that has a negative impact on the woman's well-being and/or functioning” [1], is a significant public health problem, particularly in developing countries. According to the WHO estimates, about 295,000 women died from pregnancy-related causes in 2017 (*i.e*. 808 women every day) [2], and approximately three-fourth of these maternal mortality were due to maternal morbidity [3]. An estimated 52 million women suffer from morbidity related to the direct and indirect obstetric causes of maternal death with millions more suffering from morbidity related to non-fatal outcomes of obstetric complications as well as indirect causes of death [4]. The five principal direct causes of maternal mortality are: severe bleeding/hemorrhage, infection/-sepsis, unsafe abortion, eclampsia/hypertension, and obstructed labor. Other direct causes (ectopic pregnancy, embolism and others) account for eight percent of maternal deaths, while indirect causes such as anemia, malaria, tuberculosis and heart disease account for 20 percent of maternal deaths [5].

Improving maternal health by reducing maternal morbidity and mortality have been key concerns of the international community, particularly as part of the Millennium Development Goal (MDG) and now of the Sustainable Development Goal (SDG) [6-8]. Reducing maternal mortality is a priority of SDG 3.1 and the target is to reduce the global maternal mortality ratio (MMR) to 70 maternal deaths per 100,000 live births by 2030 and to leave no country with an MMR greater than double the global average [7]. To achieve these targets, systematic epidemiologic analysis of the levels, trends and causes of maternal deaths is required to periodically assess progress towards this goal [9, 10]. Analysis of the MMR evaluates efforts to reduce the levels, while analysis of the causes of death identifies the aetiologies to target with ongoing interventions to reduce maternal mortality. Since health of a newborn is closely linked with maternal health, reduction in morbidity during pregnancy and child birth would also reduce the infant and child mortality rate.

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About half of the global maternal deaths occur in Asia, where in most countries home-delivery of births is the norms [11, 12]. According to the 2016 Bangladesh Maternal Mortality and Health Care Survey (BMMS), 196 women died per 100,000 live births due to maternal causes each year in the country, and it has remained stalled since 2010 [13]. It has also been reported that 55% of the maternal deaths were due to Hemorrhage (31%) and Eclampsia (24%), and almost half (49%) of women reported that they had at least one morbidity during pregnancy/delivery or after delivery. The contribution of the morbidities during pregnancy to high MMR in the country deserves attention.

It is, therefore highly important to understand the pattern and determinants of maternal morbidity, so that effective policy interventions can be developed to reduce maternal morbidity in Bangladesh, which in turn would reduce maternal mortality as well as child mortality to achieve the SDGs. Thus the objectives of this study are to investigate the pattern of maternal morbidities during pregnancy and identify the predictors of maternal morbidities during pregnancy in Bangladesh, using the 2019 Bangladesh Multiple Indicator Cluster Survey (BMICS) data.

MATERIALS AND METHODS

Data Source and Survey Design

The data for the study was obtained from the 2019 Multiple Indicator Cluster Survey (MICS) in Bangladesh. The survey was implemented by the Bangladesh Bureau of Statistics (BBS) with the technical and financial support from the UNICEF Bangladesh, as part of the Global MICS Program. The Global MICS Program was developed by the UNICEF in the 1990s as an international multi-purpose household survey program to assist participating countries in collecting a wide range of indicators on the situation of children and women. Data was collected during January- June 2019.

The sample for the Bangladesh MICS was designed to provide statistically reliable estimates of most indicators, at the national level, for urban and rural areas, eight divisions of the country (Barishal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur and Sylhet), and for the 64 districts. The main sampling strata included urban and rural areas within each district. A two-stage, stratified cluster sampling approach was used for the selection of the survey sample. The sampling frame was based on the 2011 Bangladesh Census of Population and Housing. The primary sampling units (PSUs) selected at the first stage were the enumeration areas (EAs) defined for the census enumeration. EAs were considered as clusters in the survey. Within each stratum, a specified number of census EAs was selected with probability proportional to size (PPS) sampling method. The sample size for the Bangladesh MICS was calculated as 64,400 households. The number of households selected per cluster (or EA) for the survey was determined as 20 households, based on a number of considerations, including the design effect, the budget available, and the time that would be needed per team to complete one cluster. A listing of households was conducted in each sample EA, and a sample of 20 households was selected at the second stage, resulting in a total of 3,220 EAs or clusters selected for the survey. Out of 64,400 selected households, 61,242 households were successfully interviewed, resulting in a household response rate of 95%. In the interviewed households, 68,711 married women (age 15-49 years) were identified for interview. Of these, 64,378 were successfully interviewed, yielding a response rate of 93.7 percent within the interviewed households. The MICS in Bangladesh considered married women of reproductive age. Data was collected by a group of trained field workers through face-to-face interview of the selected respondents using paper questionnaire. In this study, we have considered married women who were pregnant at the time of survey. After excluding missing cases, 2722 women records were used in this study who was pregnant at the time of survey.

Variables Included in the Study

The outcome variable of the study is pregnancy related morbidity. The survey covered eight different types of pregnancy related morbidities, namely, seizures or convulsions, increased blood pressure, eclampsia, blurred vision, high fever, smelly discharge, vaginal bleeding, and eyes/skin turn yellow. Women were asked whether they had any of these morbidities or complications during current/last pregnancy with a response as yes or no. On the basis of responses, we have created a composite index of number of pregnancy related morbidities, with a minimum value of zero indicating that the women did not have any morbidity and a maximum value of eight indicating that the women experienced all the eight afore mentioned morbidities.

Mothers' socio-economic and demographic characteristics were considered as explanatory variables. These included maternal age (<20, 20-34, 35+), parity (0, 1-2, 3+), division (Barisal, Chittagong,

Dhaka, Khulna, Rajshahi, Rangpur and Sylhet), place of residence (urban and rural), mother's educational level (no or pre-primary, primary, secondary, higher secondary and above), any media exposure (yes or no), migration status (never moved, move within last 5 years, moved 5+ years ago), wealth quintile (a composite indicator which divides the households into five categories: poorest, poorer, middle, richer and richest; and were derived using principle component analysis based on information from housing characteristics and ownership of household durable goods) [14], whether the pregnancy was wanted at the time (yes or no), and ethnicity (Bengali, other).

Statistical Analysis

The data were analyzed using univariate (frequency distribution), bivariate and multivariate statistical methods. Frequency distribution was used to describe the prevalence of morbidities and number of morbidities In bivariate analysis simple summary statistic (*i.e*. mean) of the count variables such as the number of morbidities during pregnancy were obtained for each category of the selected explanatory variables to examine the unadjusted but statistically significant relationship between dependent variables and selected explanatory variables. The statistical significance was tested by the analysis of variance (ANOVA) as the outcome variable was count variable. A p value <0·05 was considered statistically significant. Multivariate statistical analyses using generalized linear model (GLM) approach were carried out to ascertain the determinants of the number of morbidities. Since our response variable is a count variable, Poisson regression model with a log link is the natural selection [15]. However, the most serious limitation of the Poisson regression is that it assumes that the variance of the distribution of the count response variable is equal to its mean which is usually termed as *equidispersion* property. In practical applications, this assumption is often violated as the variance can either be larger (over dispersion) or smaller (under dispersion) than the mean. If the equidispersion assumption is violated, the estimates in Poisson regression model are still consistent but produce invalid inferences about the parameters [16]. For overdispesed count variable, Negative Binomial (NB) regression or Generalized Poisson regression are the alternative models for data analysis. In a recent study, Hossian *et al*. [17] observed that NB is the best choice for analyzing the overdispersed count data. Since, our response variable is an overdispesed (mean=0.62, variance=1.92) count variable, we employed NB regression model for estimating the regression coefficients. Finally, the risk ratios (RRs) and the corresponding 95% confidence interval were calculated for each category of the predictors. The statistical software packages SPSS 25 was used for all statistical analysis.

RESULTS

Table **1** shows prevalence of eight different morbidities considered in this study. The results indicate that among all pregnant women, 1.2% experienced life-threating pregnancy related morbidity seizures or convulsion, 4.8% experienced increased blood pressure, and 7.4% experienced eclampsia. About 13% women experienced blurred vision and 10.2% faced high fever. The prevalence of smelly discharge, vaginal bleeding and eyes/skin turn yellow were 1.7%, 1.5% and 1.8% respectively.

Table 1: Frequency and Percentage of Pregnancy Complications Among Currently Pregnant Women, BMICS 2019

Morbidities	Number (n=2722)	Percent
Seizures or convulsions	31	1.2
Increased blood pressure	131	4.8
Eclampsia	200	7.4
Blurred vision	348	12.8
High fever	278	10.2
Smelly discharge	47	1.7
Vaginal bleeding	41	1.5
Eyes/skin turn yellow	50	1.8

Table **2** presents the distribution of the women according to the number of during pregnancy. It is evident that 13.0% of the pregnant women in Bangladesh experienced any one of the morbidity, while 14.1% experienced at least two morbidities during their pregnancy.

Table 2: Distribution of Number of Morbidity during Pregnancy BMICS 2019

Number of Morbidities	Frequency	Percentage
0	1985	72.9
1	354	13.0
2	113	4.1
3	105	3.8
4	95	3.5
5+	71	2.7
Total	2722	100.0

Table **3** presents the results of the bivariate analysis of the summary statistics of the number of morbidities, such as the mean number of morbidities across a set of selected socio-economic and demographic characteristics of women. The analysis indicate that parity of mothers, administrative region, mass media exposure, wealth quintile, pregnancy wanted, migration status and ethnicity have significant differential effects on the mean number of morbidities. Morbidities are likely to increase with the parity of mothers. The mean number of morbidities widely varies with the administrative divisions of Bangladesh. Among the eight division, mean morbidity was found to be highest in Barisal division (1.04) followed by Chittagong division (0.77)), Mymensingh division (0.72), Rajshahi division (0.70), and lowest in Sylhet division (0.38). Non-migrants were more likely to have higher mean number of morbidity than migrant women. Women with poorest wealth quintile have higher average number of morbidity than their richest counterparts (0.72 vs 0.54, p=0.043). Mean morbidity was found to be higher among women who had no media exposure compared to the women who had media exposure (0.73 vs 0.57, p=0.003). Mean morbidity was higher among the women who did not want the last pregnancy. Morbidity likely to be higher among the women other than Bengali.

Table 3: Mean Number of Morbidity with 95% CI According to the Background Characteristics, BMICS 2019

	Number of Morbidity		
	Mean	**95% CI**	**p-value**
Total	0.62	0.56, 0.67	
Age			0.078
<20	0.54	0.45, 0.63	
20-29	0.65	0.57, 0.73	
30-34	0.56	0.45, 0.67	
35+	0.80	0.68, 0.92	
Mean (SD)			
Area of residence			0.464
Urban	0.66	0.54, 0.78	
Rural	0.61	0.56, 0.67	
Division			<0.001
Barisal	1.04	0.74, 1.34	
Chittagong	0.77	0.65, 0.88	
Dhaka	0.49	0.40, 0.57	
Khulna	0.57	0.42, 0.72	
Mymensingh	0.72	0.50, 0.94	
Rajshahi	0.70	0.55, 0.85	
Rangpur	0.50	0.36, 0.65	
Sylhet	0.38	0.24, 0.52	
Migration			0.013
Never moved	0.71	0.57, 0.84	
Moved within the last 5 yrs	0.53	0.46, 0.60	
Moved 5+ years ago	0.67	0.59, 0.76	
Mother's education			0.067
Pre-primary or none	0.53	0.35, 0.70	
Primary	0.74	0.62, 0.86	
Secondary	0.61	0.54, 0.68	
Higher secondary+	0.55	0.45, 0.66	
Wealth index quintile			0.043
Poorest	0.72	0.59, 0.85	
Poorer	0.60	0.48, 0.71	
Middle	0.71	0.59, 0.83	
Richer	0.56	0.45, 0.66	
Richest	0.54	0.44, 0.64	
Any media exposure			0.003
Yes	0.57	0.47, 0.66	
No	0.73	0.67, 0.79	
Wanted pregnancy			0.004
Yes	0.58	0.52, 0.63	
No	0.75	0.63, 0.86	
Ethnicity			<0.001
Bengali	0.61	0.56, 0.66	
Other	1.91	1.20, 2.62	
Parity			0.003
0	0.57	0.49, 0.65	
1-2	0.62	0.55, 0.68	
3+	0.88	0.66, 1.11	

The foregoing bivariate analysis presents unadjusted effects of the explanatory variables on mean number of morbidities. To identify the adjusted effect of an explanatory variable on frequency of morbidity, we employed multiple Negative Binomial regression model, since our outcome variable is an overdispersed (variance > mean) count variable. The adjusted effect of an explanatory variable was measured by the incidence rate ratio (IRR) after controlling the effects of all other explanatory variables. The results are presented in Table **4**.

Table 4: Negative Binomial (NB) Regression Analysis of Morbidity Count

Factors	B	Std. Error of B	NB regression analysis of morbidity count		
			IRR	95% CI for IRR	p-value
Age					
< 20	0.065	0.1341	1.06	0.82, 1.38	0.628
20-24	0.114	0.1077	1.12	0.91, 1.38	0.290
25-29	0.300	0.1028	1.34	0.97, 1.65	0.053
30+			1.00		
Parity					
0			1.00		
1-2	0.277	0.1561	1.32	0.97, 1.71	0.085
3+	0.418	0.1222	1.52	1.18, 2.03	0.001
Mother's education					
Pre-primary or none	-0.198	0.1579	0.82	0.60, 1.11	0.211
Primary	0.079	0.1125	1.08	0.86, 1.34	0.484
Secondary	-0.011	0.0940	0.98	0.82, 1.18	0.903
Higher secondary+			1.00		
Media exposure					
No	0.214	0.0749	1.24	1.07, 1.43	0.004
Yes			1.00		
Place of residence					
Urban	0.169	0.0889	1.18	1.03, 1.98	0.047
Rural			1.00		
Administrative division					
Barisal	1.026	0.1761	2.78	1.97, 3.93	<0.001
Chittagong	0.791	0.1410	2.20	1.67, 2.90	<0.001
Dhaka	0.485	0.1447	1.62	1.22, 2.15	<0.001
Khulna	0.602	0.1673	1.82	1.31, 2.53	<0.001
Mymensingh	0.809	0.1683	2.24	1.61, 3.12	<0.001
Rajshahi	0.754	0.1602	2.12	1.55, 2.90	<0.001
Rangpur	0.433	0.1659	1.54	1.11, 2.13	0.009
Sylhet			1.00		
Ethnicity					
Bengali	-1.350	0.2674	0.26	0.15, 0.43	<0.001
Other			1.00		
Wealth index quintile					
Poorest	0.045	0.1329	1.05	0.81, 1.35	0.738
Poorer	-0.098	0.1289	0.91	0.70, 1.16	0.448
Middle	0.216	0.1156	1.24	0.99, 1.55	0.062
Richer	0.088	0.1095	1.09	0.88, 1.35	0.422
Richest			1.00		
Wanted pregnancy					
Yes	-0.231	0.0746	0.72	0.61, 0.92	0.008

No			1.00		
Migration					
Never moved	-0.251	0.0911	0.78	0.65, 0.93	0.006
Moved within the last 5 yrs	-0.002	0.0930	0.99	0.83, 1.19	0.985
Moved 5+ years ago			1.00		

The regression analysis identified, parity, administrative division, place of residence, media exposure, wanted pregnancy, migration status and ethnicity as significant predictors of frequency of morbidity in Bangladesh (Table **4**). The risk of morbidity increase with the parity. For example, mothers with parity 3 or more were found to be 1.5 times more likely to have at least one morbidity during pregnancy than the mothers with 0 parity or with first time pregnancy (IRR=1.52, 95% CI: 1.18 – 2.03, p=0.001). Among the eight administrative divisions, mothers who were living in Barisal, Chittagong, Mymensingh and Rajshahi had more than 2 fold higher risk of experiencing at least one morbidity during pregnancy compared to mothers who were living in Sylhet division. Mothers from Dhaka, Khulna and Rangpur divisions also had 1.6, 1.8 and 1.5 times higher risk of experiencing at least one morbidity during pregnancy, respectively, than the mothers from Sylhet division. Mothers from urban area were 1.18 times more likely to experience at least one morbidity during pregnancy than their counterparts in rural area (IRR=1.18, 95% CI: 1.03-1.98). As expected, the mothers who desired the index pregnancy were found to be 28% less likely to experience at least one morbidity during pregnancy compared to the mothers who did not (IRR=0.72, 95% CI: 0.61, 0.92, p=0.008). Mothers having no media exposure were found to be 1.24 times more likely to experience at least one morbidity during pregnancy than the mothers with at least one media exposure (IRR=1.24; 95% CI: 1.07-1.43, p=0.004). Mother's mobility status appeared as a significant predictor of maternal morbidity. Mothers who did not experienced any change of the residential place were less likely to experience at least one morbidity during pregnancy than the mothers who moved 5 or more years age (IRR=0.78, 95% CI: 0.65 – 0.93, p=0.006). Mothers with ethnicity other than Bengali were found to be 74% higher risk of morbidity during pregnancy than the mothers with ethnicity Bengali (IRR=0.26, 95% CI: 0.15 – 0.43, p<0.001).

DISCUSSIONS

Maternal morbidity broadly defined as any pregnancy related complications that can occur during pregnancy, childbirth and postpartum period. Thus the reported morbidity during pregnancy period covers only a part of the overall maternal morbidity. A previous study in Bangladesh reported that overall, 65.7% of women reported at least one morbidity, with 18.0% of women reporting a morbidity during pregnancy, 30% of women reported at least one morbidity during delivery, and 51.8% of women reported at least one morbidity during the postpartum period [18]. Our study mainly focused on the prevalence and determinants of maternal morbidities during their pregnancy period in Bangladesh.

The term maternal morbidity is not universally used in the literature. Studies often report "maternal health problems," "complications," and "maternal morbidity" interchangeably. The estimated prevalence of maternal morbidities also varies greatly among countries. For example, in West Africa the incidence of delivery-related morbidity in a large prospective study ranged between 2.8% to 8.4% in seven cities with great variability in complications reported [19]. This variability is due to three causes: 1) differing numbers of health conditions subsumed under "maternal morbidity", 2) differing definitions of the same condition, and 3) differing methods of measurement.

Our results indicate that about 13% women experienced any one of the morbidities during pregnancy period, while 14% women reported that they experienced at least two morbidities during their last pregnancy. Overall, 1.2% of the women faced life-threating morbidity seizure or convulsion during pregnancy period in Bangladesh. The rate is lower than observed among women in urban slums in Bangladesh, reporting 2.7% convulsion [17]. About 7.4% women were reported to have had eclampsia during pregnancy. Blurred vision (12.8%) and high fever (10.2%) were the two most frequently cited morbidities in Bangladesh.

The findings of this study reveals parity, place of residence, administrative division, media exposure, wanted indexed pregnancy, migration status, and ethnic as the significant predictors of maternal morbidity during pregnancy in Bangladesh.

Women with higher parity have greater risk of experiencing maternal morbidities during pregnancy. Generally, in high order births (more than three) women experience multiple and life-threatening complications. Multiparous women are usually older and less likely to have accesse to antenatal care, which results in an increased risk of maternal morbidities and poor neonatal outcomes [20-22].

Mothers with unwanted pregnancies also had an increased risk of facing pregnancy related morbidities. Effective family planning program would allow better access to contraception especially for the women who are at risk for unwanted pregnancy.

Migration status of mother was also a responsible factor for increasing morbidities during pregnancy in Bangladesh. Women who were classed as a migrant experienced more pregnancy related morbidities compared to native women. The possible reason might be that women who migrated to urban lagged in getting health care services [23, 24], and were disadvantaged by wealth index moderately than urban native women [24].

Urban women were found to be more likely to experienced morbidity during pregnancy than rural women. With growing urbanization, more and more women living in urban areas are exposed to risk factors originating from the urban social or physical environment, contributing to increased stress, which in turn is negatively associated with mental health [25]. Besides, high population density, poor living condition, low socioeconomic status, low social capital, higher rates of pollution, and physical threats (*e.g.*, violence and higher crime rates) [26] greatly affect the urban life. The wide variation across the administrative division might be related to the variation in the implementation of the health care program, cultural variation and socio-economic condition of the women. As expected, women having no media exposure were more likely to experience morbidity during pregnancy. This might be due to the fact that media exposure increases women's knowledge about pregnancy related complications or morbidities and utilization of maternity care during pregnancy.

This study is not free from limitations. The study considered reported maternal morbidity cases during pregnancy period only, which did not cover the whole spectrum of maternal morbidity such as maternal morbidity during child birth and during postpartum period. The morbidities reported in this study are based on self-reports. Research has shown that women's self-reports of obstetric complications do not accurately correspond to medical diagnoses, and tend to over- or under-estimate complications [27-30].

CONCLUSIONS

This study has important implications for public health program in Bangladesh for further improvement of maternal and newborn health and survival. The high burden of maternal morbidities and their direct and indirect association with maternal deaths, stillbirth, and neonatal deaths highlight the necessity for improving health of women by promoting quality antepartum, intrapartum, and postpartum care. Besides, it is important to take strict measure for implementing early and adequate number of antenatal care visits (minimum 8 visits starting from 1st trimester of pregnancy as recommended by WHO) for early identification and treatment of pregnancy related morbidities. The findings of this study revealed that there are many social-economic and demographic factors that were associated with maternal morbidities during pregnancy in Bangladesh. The identified factors are mothers' parity, place of residence, region of residence, media exposure, pregnancy wanted or not, migration status and ethnicity. To reduce pregnancy related maternal mortalities, special attention should be given to urban, rural-urban migrants and ethnic non-Bengali mothers so that they can get sufficient access to health care services. Reduction of unwanted pregnancy can play a vital role for reducing pregnancy related morbidities and hence maternal deaths. More effective care during pregnancy/delivery is needed for mothers with high parity. The higher rate of maternal morbidities during pregnancy in Barisal, Chittagong, Mymensingh and Rajshahi regions need special attention from health care program perspectives.

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ETHICAL APPROVAL

Ethical approval was not applicable for this study, because the study is based on secondary analysis of the publicly available MICS dataset which can be downloaded online for research purpose by request.

MICS data are available from UNICEF's database at http://mics.unicef.org/surveys. Informed consent was obtained in the survey from all the respondents before conducting interview.

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DECLARATIONS OF INTEREST

None.

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