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## Real-world clinical and survival outcomes of patients with early relapsed triple-negative breast cancer from the ESME national cohort

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**Keywords:** metastatic breast cancer, triple negative breast cancer, early relapse, overall survival, real-world-data,

**Database registration:** clinicaltrials.gov Identifier NCT032753

**Abstract:****Background:**

Early metastatic relapse of triple-negative breast cancer (mTNBC) after anthracyclins and/or taxanes based (A/T) primary treatment represents a highly aggressive cancer situation requiring urgent characterization and handling. ESME-metastatic breast cancer (MBC) database, a multicenter, national, observational cohort (NCT03275311) provides recent data on this entity.

**Methods:**

All ESME patients diagnosed between 2008 and 2020 with mTNBC occurring as a relapse after a systemic neoadjuvant/adjuvant taxane and/or anthracycline-based chemotherapy were included. Early relapses were defined by a metastatic diagnosis up to 12 months of the end of neo/adjuvant A/T chemotherapy. We assessed overall survival (OS) and progression-free-survival under first-line treatment (PFS1) by early versus late relapse ( $\geq 12$  months).

**Results:**

Patients with early relapse (N= 881, 46%) were younger and had a larger tumor burden at primary diagnosis than those with late relapses (N=1 045). Early relapse rates appeared stable over time. Median OS was 10.1 months (95%CI 9.3-10.9) in patients with early relapse versus 17.1 months (95%CI 15.7-18.2) in those with late relapse (adjusted Hazard-ratio (aHR): 1.92 (95%CI 1.73-2.13);  $p < 0.001$ ). The median PFS1 was respectively 3.1 months (95%CI 2.9-3.4) and 5.3 months (95%CI 5.1-5.8); (aHR: 1.66; [95%CI 1.50-1.83];  $p < 0.001$ ). Among early relapsed patients, a higher number of metastatic sites, visceral disease but not treatment types, were independently associated with a poorer OS.

**Conclusion:**

These real-world data provide strong evidence on the dismal prognosis, higher treatment resistance and major unmet medical need associated with early relapsed mTNBC.

**Key words:**

breast cancer, triple-negative breast cancer, real-world data, ESME cohort, overall survival, ESME cohort

**Article****Introduction**

Breast cancer is currently the leading cause of cancer death among women worldwide (1). While genomics allowed us to enhance our understanding of its biology, the so-called “triple-negative” breast

cancer subtype (TNBC), defined by the lack of expression of the estrogen and progesterone receptors (ER and PgR) as well as absence of HER2 protein overexpression or gene amplification, remains the most aggressive and genomically complex entity (2). One of its major characteristics is the lack of identified recurrent genomic drivers, which comes with lack of common molecular targets for treatment. TNBC is even more worrying as it occurs more often among young and premenopausal women.

While multimodal treatments allows the cure of about 60-65% of early TNBC patients, distant metastases most often occur within three years from diagnosis, particularly in the viscera (brain, lung and liver) with a subsequent median overall survival (OS) of less than 15 months (3–5). Chemotherapy has long been the backbone treatment of advanced/metastatic TNBC (mTNBC). Taxane-based first-line treatment allows an objective response rate (ORR) of approximately 50% and a progression free survival (PFS) of at most 5-6 months among non-exposed patients or late relapsers (6). Many trials tested different approaches and combinations with little or no success (7). However, immune checkpoint inhibitors, antibodies drug conjugates (ADC) and PARP inhibitors have recently brought significant improvements in progression-free survival and, for some of them, overall survival in the treatment of certain mTNBC subsets (8–11).

A clinically defined subgroup of mTNBC stands out for its particularly aggressive course, with rapid progression of metastases and marked treatment resistance. This clinical subgroup consists of patients with an early relapse, occurring up to one year after completion of neo/adjuvant therapy. A disease-free interval of less than one year is a marker of chemotherapy resistance (12,13). In addition, the use of different types of treatment at the localized stage limits treatment options in this subgroup. Several recent pivotal trials in the first metastatic line treatment setting have excluded these patients (6,8,14). Although there are few specific data available, this subgroup may account for 26% to 43% of all patients with mTNBC (15–18), however, a comprehensive description of this population lacks in the literature.

Real-world data help describe patients, treatments and outcomes, especially for populations under-represented in clinical trials but observed in routine practice (19). ESME-MBC (Epidemiology-Strategy-Medico-Economical-Metastatic Breast Cancer) is a large, nationwide, multicenter real-world database of patients with MBC (4,20). In this study, the aim of this study was to describe and compare the characteristics and survival outcomes of women with early relapsed metastatic breast cancer to those with late relapsed metastatic breast cancer in a real-world population of 30,459 women who started treatment for metastatic breast cancer in the ESME cohort between January 1, 2008 and December 31, 2020.

## **Patients and Methods**

### Data source and setting

We carried out a retrospective study using the ESME-MBC (NCT03275311) database, a national observational cohort gathering routinely collected real-world data from all consecutive patients aged 18 and over and who initiated treatment for MBC in one of the 18 French Comprehensive Cancer Centers. Data are updated annually and include patient demographics, histopathology, outcomes, and treatment patterns. The information collected integrates patients' data from medical records, hospitalization reports and hospitals' pharmacy records. More details can be found in previously published descriptions of the cohort (4,20,21). For the purpose of reporting this study's results, we followed the STROBE guidelines (22).

### Ethics approval and data protection

The present analysis was approved by an independent Ethics Committee (Comité De Protection Des Personnes Sud-Est II- 2015-79). The French data protection authority authorized the ESME MBC database in 2013 (Registration ID 1704113 and authorization NbrDE-2013.-117). In compliance with the applicable European regulations, a complementary authorization was obtained on 14/10/2019 regarding the ESME research Data Warehouse.

### Study participants' eligibility

For the present study, we used data from MBC patients who entered the cohort between January 2008 and December 2020. Data were collected until the cut-off date for data extraction, February 2022. The triple negative breast cancer subtype was defined according to locally performed immunohistochemical (IHC) analyses on primary tumour samples. Tumours were considered triple negative if both ER and PgR expression was <10% of tumour cells as standard in France, and HER2 expression was 0 or 1, or 2 with a negative fluorescence or chromogenic in-situ hybridization (FISH/CISH) test (23–25). Patients with early relapsed mTNBC were defined as having a diagnosis of distant metastases up to 12 months of the last dose of neo/adjuvant anthracycline and/or taxane chemotherapy, in patients whose tumor was initially considered as a localized TNBC with an initial stage up to III (12,13). Male patients, those without systemic treatment at metastatic stage with other subtypes or stage 0 or IV disease at initial diagnosis were excluded. Those who had metastatic progression diagnosed more than 12 months after the completion of neo/adjuvant chemotherapy were defined as late relapsed patients. The time to relapse was calculated from the end of the taxane and/or anthracycline-based chemotherapy to the date of metastatic relapse. First-line treatments were separated into monotherapy and combination therapy (combination of agents administered concomitantly or sequentially if started within 2 months of a first agent).

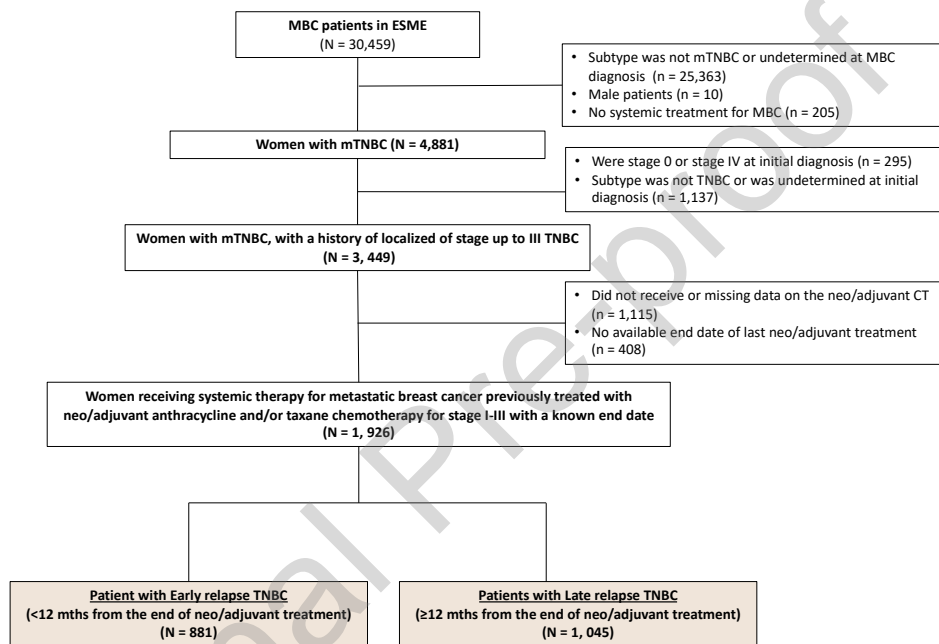
## Statistical analyses:

We first described early and late relapsed mTNBC patients' characteristics. Quantitative variables are described using the number of observations, median, first and third quartile values. Qualitative variables are described using number of observations and percentage distribution. The number of missing data are presented but not considered for the percentage calculation. Characteristics were compared using Pearson's Chi-squared and Kruskal-Wallis rank sum tests (no p-value adjustment was performed). The median follow-up time was estimated using the reverse Kaplan-Meier method. OS was defined as the time from the date of metastatic diagnosis to the date of death (any cause) or to the date of last follow-up for censored patients. PFS1 was defined as the time from initiation of the first line treatment in metastatic setting to the date of MBC disease progression or death from any cause, or to the date of last follow-up for censored patients, whichever occurred first. Progression-free survival 2 (PFS2) was defined as the time from initiation of first-line treatment in metastatic setting to the date of disease progression on second-line treatment, the date of death from any cause or the date of last news for censored patients, whichever came first. OS, PFS1 and PFS2 were estimated using the Kaplan-Meier method. A sensitivity analysis was performed using an alternative definition of patients with early relapse, as the presence of metastatic progression diagnosed between 6-18 months from the primary tumour diagnosis or from the diagnosis of a local relapse patients relapsing within 6 months of primary tumor diagnosis are considered de novo metastatic in ESME and therefore excluded from this definition). (5,20). Multivariable Cox proportional hazard models were performed using a backward stepwise selection to identify prognostic factors for OS and PFS1 in early and late relapse mTNBC. Multivariable Cox proportional hazard models were performed using a backward stepwise selection to identify prognostic factors for OS and PFS1 among early and late relapse metastatic TNBC. The covariates were selected using a conservative p value of 0.10 from the univariable analysis, except for certain covariates which were "forced" into either models if not present since strongly recognized as prognostic factors in the literature and/or clinically relevant (taxanes use in early setting, number and sites of metastases at diagnosis of MBC, age groups, time interval from initial diagnosis) (5). The choice of covariates for each multivariable model is described in Supplementary Method 1. A second sensitivity analysis repeated the same analyses among patients with an available performance status at baseline. Both sensitivity analyses were focused on OS. Finally, we performed an analysis of the characteristics of patients excluded because of missing data. The independent prognostic factors included in the final models with a significant *p-value* of 0.05 are presented with their hazard ratios including 95% confidence intervals. All analyses were performed using R Statistical Software version 4.0.0.

## Results

### Characteristics of patients and tumors by early versus late relapses

Of the 30,459 patients registered in the ESME database, 1,926 women had a relapsed mTNBC following receipt of a neo/adjuvant treatment and were eligible for the present study (whole population) (Figure 1). Of them, 881 (45.7%) and 1,045 (54.3%) had an early and late relapse respectively. The clinical and tumors' characteristics are presented in Table 1. The analysis of the characteristics of the excluded patients is presented in Supplementary Table 1.



**Figure 1: Flow Chart**

MBC: Metastatic breast cancer, ESME: Epidemio-Strategy-Medico-Economical-Metastatic Breast Cancer, TNBC: triple negative breast cancer, mTNBC, metastatic TNBC, CT: chemotherapy

Patients with early relapse were significantly younger (median age [q1-q3], 51 [42-60] vs 56 [46-66] years,  $p < 0.001$ ) and had less frequent detection of a *BRCA1/2* germline mutation at metastatic diagnosis (5.6% vs 7.6%, unadjusted  $p < 0.001$ ) compared to patients with late relapse. The primary tumor burden was greater among early relapsers (T3/T4, 49.6% vs 31.5%, lymph node involvement N2/N3, 23.1% vs 8.7%, both unadjusted  $p < 0.001$ ). Although patients with early relapse had slightly significantly less metastatic sites at metastatic diagnosis compared to those with late relapse, type of involvement appeared identical (17% brain metastases, 51-54% visceral metastases excluding CNS involvement). Finally, the proportion of patients per period of diagnosis remained rather similar between early and late relapse groups.



Table 1. Patients and tumors characteristics and description of prior treatments according to the early/late relapse status

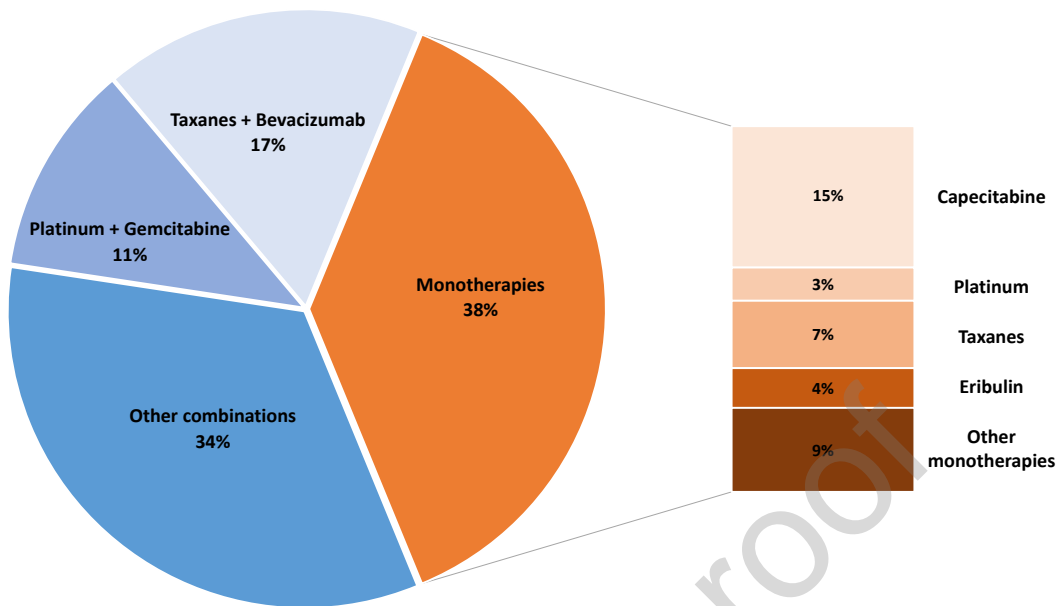
	Early relapse (N=881)	Late relapse (N=1045)	Whole study sample (N=1926)	p value
<b>Age at MBC diagnosis (years)</b>				<b>&lt; 0.001<sup>2</sup></b>
Median (q1, q3)	51 (42, 60)	56 (46, 66)	53 (44, 63)	
<b>Age groups at MBC diagnosis (years)</b>				<b>&lt; 0.001<sup>1</sup></b>
<50	420 (47.7%)	354 (33.9%)	774 (40.2%)	
>=50	461 (52.3%)	691 (66.1%)	1152 (59.8%)	
<b>Germline BRCA1/2 alteration at MBC diag</b>				<b>&lt; 0.001<sup>1</sup></b>
Germline BRCA1/2 alteration	49 (5.6%)	79 (7.6%)	128 (6.6%)	
Other germline alteration	1 (0.1%)	1 (0.1%)	2 (0.1%)	
Absence of germline alteration	225 (25.5%)	189 (18.1%)	414 (21.5%)	
No genetic testing	606 (68.8%)	776 (74.2%)	1382 (71.8%)	
<b>Histological type of primary tumour</b>				<b>0.024<sup>1</sup></b>
Invasive ductal carcinoma	780 (88.5%)	879 (84.1%)	1659 (86.1%)	
Invasive lobular carcinoma	22 (2.5%)	48 (4.6%)	70 (3.6%)	
Other	79 (9%)	118 (11.3%)	197 (10.3%)	
<b>HER2 status</b>				0.099 <sup>1</sup>
HER2 0	714 (81.0%)	815 (78.0%)	1529 (79.4%)	
HER2 low (1+ or 2+ but non amplified)	167 (19.0%)	230 (22.0%)	397 (20.6%)	
<b>T status at initial diag.</b>				<b>&lt; 0.001<sup>1</sup></b>
T0/Tis	2 (0.5%)	9 (1.9%)	11 (1.2%)	
T1	54 (12.5%)	95 (20.5%)	149 (16.6%)	
T2	162 (37.4%)	214 (46.1%)	376 (41.9%)	
T3	114 (26.3%)	103 (22.2%)	217 (24.2%)	
T4	101 (23.3%)	43 (9.3%)	144 (16.1%)	
Missing	448	581	1029	
<b>N status at initial diag.</b>				<b>&lt; 0.001<sup>1</sup></b>
N0	156 (37.1%)	227 (50.7%)	383 (44.1%)	
N1	167 (39.8%)	182 (40.6%)	349 (40.2%)	
N2	53 (12.6%)	25 (5.6%)	78 (9.0%)	
N3	44 (10.5%)	14 (3.1%)	58 (6.7%)	
Missing	461	597	1058	
<b>Histological grade at initial diag.</b>				<b>&lt; 0.001<sup>1</sup></b>
I/II	219 (25.9%)	347 (34.2%)	566 (30.4%)	
III	627 (74.1%)	669 (65.8%)	1296 (69.6%)	
Missing	35	29	64	
<b>Year of MBC diagnosis (YOD)</b>				0.372 <sup>1</sup>
2008-2012	350 (39.7%)	409 (39.1%)	759 (39.4%)	
2013-2017	348 (39.5%)	441 (42.2%)	789 (41.0%)	
2018-2020	183 (20.8%)	195 (18.7%)	378 (19.6%)	
<b>MBC diagnosis circumstances</b>				<b>0.014<sup>1</sup></b>
Symptom(s)	415 (47.9%)	548 (53.6%)	963 (51.0%)	
Systematic examination	451 (52.1%)	474 (46.4%)	925 (49.0%)	
Missing	15	23	38	
<b>Performance Status at MBC diag.</b>				0.071 <sup>1</sup>

0	179 (33.8%)	261 (40.3%)	440 (37.4%)	
1	234 (44.2%)	261 (40.3%)	495 (42.1%)	
2-4	116 (21.9%)	125 (19.4%)	241 (20.5%)	
Missing	352	398	750	
<b>Time interval to relapse from the end of neo/adjvant A/T chemotherapy (months)</b>				<b>&lt; 0.001<sup>2</sup></b>
Median (q1,q3)	6.31 (3.12, 8.87)	23.92 (16.59, 39.75)	13.14 (6.77, 25.71)	
[0-6[	419 (47.6%)	0 (0.0%)	419 (21.8%)	
[6-12[	462 (52.4%)	0 (0.0%)	462 (24.0%)	
>=12	0 (0.0%)	1045 (100.0%)	1045 (54.2%)	
<b>No. of metastatic sites at MBC diag.</b>				<b>&lt; 0.001<sup>1</sup></b>
1	441 (50.1%)	454 (43.4%)	895 (46.5%)	
2	227 (25.8%)	253 (24.2%)	480 (24.9%)	
≥3	213 (24.1%)	338 (32.2%)	551 (28.6%)	
<b>Metastatic sites at MBC diag.</b>				0.448 <sup>1</sup>
Non-visceral metastases	280 (31.8%)	305 (29.2%)	585 (30.4%)	
Visceral metastases excluding CNS	454 (51.5%)	564 (54.0%)	1018 (52.8%)	
CNS metastases	147 (16.7%)	176 (16.8%)	323 (16.8%)	
<b>RT in neo/adj. setting</b>				<b>&lt; 0.001<sup>1</sup></b>
Yes	746 (84.7%)	965 (92.3%)	1711 (88.8%)	
No	135 (15.3%)	80 (7.7%)	215 (11.2%)	
<b>Taxanes in neo/adj. setting</b>				<b>&lt; 0.001<sup>1</sup></b>
Yes	823 (93.4%)	870 (83.3%)	1693 (87.9%)	
No	58 (6.6%)	175 (16.7%)	233 (12.1%)	
<b>Anthracyclines in neo/adj. setting</b>				0.128 <sup>1</sup>
Yes	835 (94.8%)	973 (93.1%)	1808 (93.9%)	
No	46 (5.2%)	72 (6.9%)	118 (6.1%)	
<b>Capecitabine in neo/adj. setting</b>				<b>&lt; 0.001<sup>1</sup></b>
Yes	116 (13.2%)	33 (3.2%)	149 (7.7%)	
No	765 (86.8%)	1012 (96.8%)	1777 (92.3%)	

MBC diag.: metastatic breast cancer diagnosis; non-visceral metastasis: bone, skin, and lymph nodes; Visceral metastasis is excluding brain; RT: Radiotherapy; neo/adj.: neo/adjuvant; CNS: Central nervous system metastases; A/T: anthracyclins/taxanes 1. Pearson's Chi-squared test, 2. Kruskal-Wallis rank sum test. No p-value adjustment was performed.

### First-line treatments received by the early relapse group

The treatment regimens received by patients with early relapsed mTNBC in first line metastatic disease are shown in Figure 2 and Supplementary Table 2. Of note, 17% of patients were included in a clinical trial as part of their first line metastatic treatment, which was equivalent to late relapsed patients.



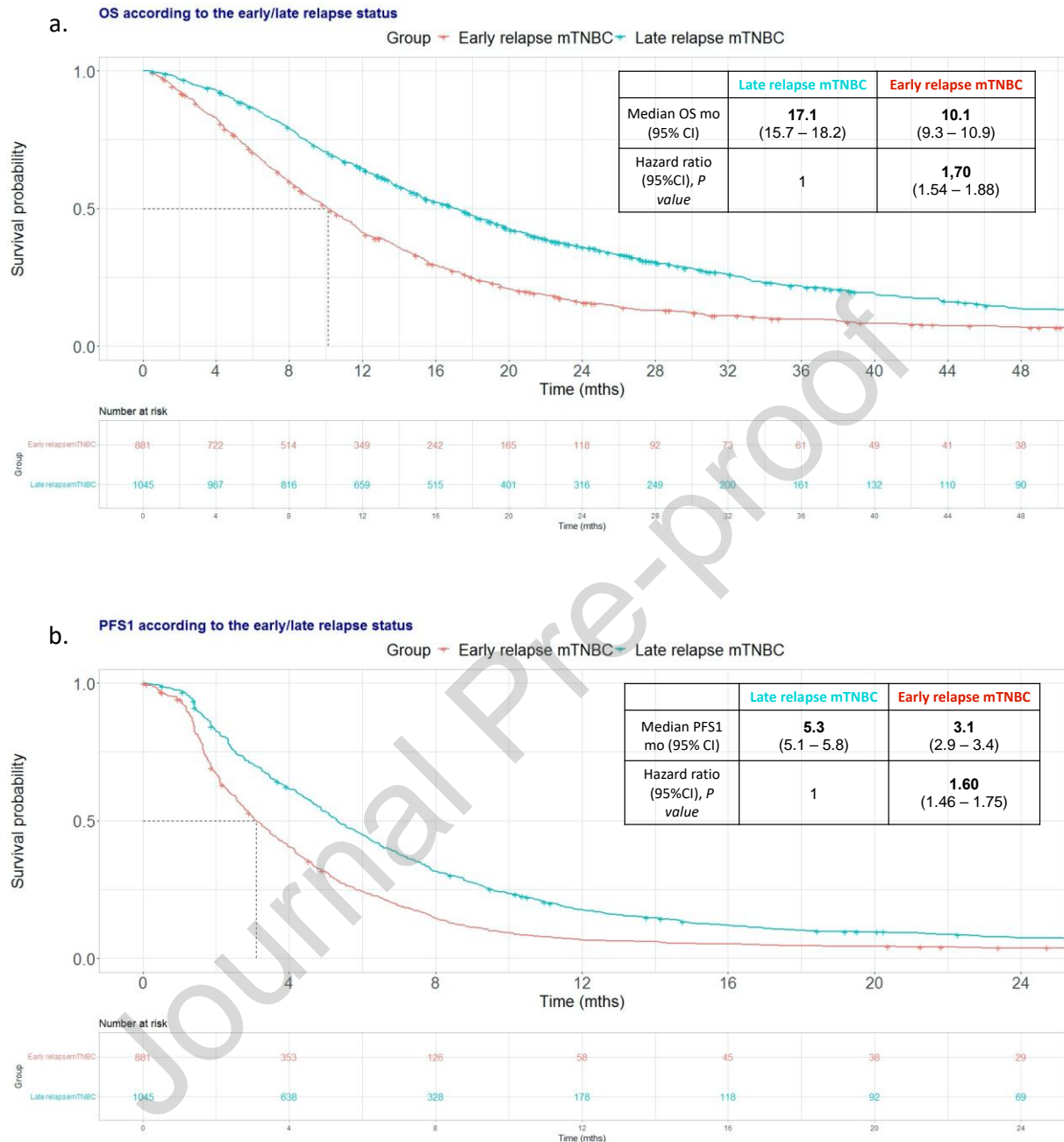
**Figure2. Type of first-line metastatic treatments of patients with early relapsed mTNBC**

Overall survival and progression-free survival of patients with early or late relapse

The median follow-up duration for the whole study sample was 57.6 months (95% CI 52.3-67.8)). It was 52.3 months (95% CI 49.0-66.3) and 64.4 months (95% CI 53.7-72.2) for the early and late relapse groups, respectively. The median OS of the entire group was 13.5 months (95% CI 12.6-14.1). Median OS was significantly worse in early versus late relapsers (10.1 months [95% CI 9.3-10.9] vs 17.1 months [95% CI 15.7-18.2]; unadjusted Hazard ratio (HR): 1.70; [95% CI 1.54-1.88];  $p < 0.001$  respectively) (Figure 3). Similarly, PFS1 and PFS2 were lower in the early compared to the late relapse group: PFS1 was 3.1 months (95% CI 2.9-3.4) vs 5.3 months (95% CI 5.1-5.8) (HR: 1.60; [95% CI 1.46-1.75];  $p < 0.001$ ) and PFS2 was 6.3 months (95% CI 6.0-6.7) versus 10.1 months (95% CI 9.4-10.8), respectively (Figure 3 and Supplementary Figure 1).

In a multivariable analysis in the whole (early + late) study sample, age at metastatic diagnosis, number of metastatic sites at metastatic diagnosis, presence of visceral metastases and taxanes exposure in neo/adjuvant setting were independently associated with overall survival. As well, early relapse was associated with OS and PFS1 with an adjusted hazard ratio (aHR) of 1.92 (95% CI 1.73-2.13;  $p < 0.001$ ) and 1.66 (95% CI 1.50-1.83;  $p < 0.001$ ), respectively (Supplementary Table 3).

In a first sensitivity analysis, where early relapse was defined as the presence of metastatic progression within 6-18 months from diagnosis of the primary tumour or local relapse diagnosis, the same OS figures were observed, with a median OS of 10.1 months (95% CI 9.2-10.9) among the 883 such defined patients (Supplementary Figure 2).



**Figure 3: Overall survival (a) and progression-free survival under first line treatment (b) according to early versus late relapse status**

#### Prognostic analyses in patients with early relapsed mTNBC

In multivariable analyses among patients with early relapsed mTNBC, time to relapse [0-6[ vs [6-12[ and number of metastatic sites were independent prognostic factors of PFS1. Time to relapse, age at metastatic diagnosis, number of metastatic sites and the presence of visceral metastases were independent prognostic factors for OS. Of note, the type of first-line treatment appeared as an

independent factor of both PFS1 and OS: compared to monotherapy, combination therapies were associated with better PFS1 (aHR 0.65 [95%CI 0.56-0.75],  $p<0.001$ ) and OS (aHR 0.78 [95%CI 0.67-0.91],  $p=0.001$ ) (Table 2). However, in a second sensitivity analysis, we repeated the multivariable analysis in patients with early relapsed mTNBC whose performance status was available (N=529). The median OS of this population was 9.3 months (95%CI 8.6-10.3) with a median follow-up time of 49 months (95%CI 42-53.5). Number of metastatic sites and presence of visceral metastases were again independent prognostic factors for OS in this sub-cohort, as was performance status, while combination therapies compared to monotherapy lost significance (aHR of 0.83 [95%CI 0.68-1.01];  $p= 0.063$ ) (Supplementary Table 4).

Table 2: Multivariable analysis of PFS1 and OS within patients with early relapsed mTNBC (N= 881)

Characteristic	PFS1			OS		
	HR <sup>1</sup>	95% CI <sup>1</sup>	p-value	HR <sup>1</sup>	95% CI <sup>1</sup>	p-value
<b>Time interval to relapse from the end of neo/adjuvant chemotherapy (mo)</b>			0.001			0.012
[0-6[	1	—		1	—	
[6-12[	0.79	0.69, 0.91		0.83	0.72, 0.96	
<b>Age groups at MBC diag. (yrs)</b>			0.24			0.037
<50	1	—		1	—	
≥50	1.09	0.95, 1.25		1.17	1.01, 1.34	
<b>No. of metastatic sites at MBC diag.</b>			<0.001			<0.001
1	1	—		1	—	
2	1.34	1.13, 1.59		1.62	1.36, 1.94	
≥3	1.90	1.57, 2.29		2.78	2.29, 3.39	
<b>Type of metastatic sites at MBC diag.</b>			0.15			<0.001
Non-visceral metastases	1	—		1	—	
Visceral metastases excluding CNS	1.03	0.87, 1.21		1.18	0.99, 1.40	
CNS metastases	1.22	0.99, 1.51		1.78	1.43, 2.21	
<b>Taxanes use in neo/adj. setting</b>			0.55			0.94
No	1	—		1	—	
Yes	1.09	0.82, 1.44		0.99	0.74, 1.32	
<b>Treatment group in m1L*</b>			<0.001			0.001
Monotherapies	1	—		1	—	
Combinations	0.65	0.56, 0.75		0.78	0.67, 0.91	

MBC diag: metastatic diagnosis, HR = Hazard Ratio, CI = Confidence Interval, non-visceral metastasis: bone, skin, and lymph nodes, Visceral metastasis excluding brain, m1L: metastatic first line treatment, yrs: years, mo: months, mTNBC: metastatic triple negative breast cancer, \*This effect disappeared after adjustment on performans status

## Discussion

Our analysis of a large, recent, multicenter cohort of mTNBC patients who developed an early relapse provides for the first-time detailed evidence on the dismal prognosis associated with this entity, as well as its clinical characteristics and treatment effect. Our data highlight the major unmet medical

need of this subgroup of patients. However, the rate of early versus late relapses appeared stable over time, which is not in favor of a potential anticipation effect of more aggressive neo/adjuvant treatments.

Among patients with early mTNBC relapse, the factors independently associated with overall survival in our cohort were classical, including number and type of metastatic sites (4,5,21). When first-line treatment type (single-agent versus combination) was included in the models, combination of therapies appeared to be associated with better PFS1 and OS than single agent approaches (aHR 0.65 [95%CI 0.56-0.75],  $p < 0.001$  and aHR 0.78 [95%CI 0.67-0.91],  $p = 0.001$ , respectively). However, these data should be interpreted with caution because of a possible confounding by indication bias. Indeed, this association disappeared when performance status was included in the model (restricted population) revealing a possible prescription bias as more aggressive combination treatments are prescribed to patients in better condition. Since a better general health condition is an independent positive prognostic factor for survival, it can bias the survival outcomes in favor of the combination group. We however tried to eliminate other possible biases by defining treatment combinations as concomitantly initiated (second agent started within 2 months of the first agent), which limits temporal biases by eliminating sequential treatment changes due to toxicity, but also maintenance treatments, linked to more prolonged responses.

The strengths of our analysis are that the ESME cohort has a high level of data quality at the collection and controls levels (20), and a wide national multicenter recruitment in a country where access to care is homogeneous (26). It is the first large cohort of patients with early relapse of mTNBC using time from end of initial anthracyclins and taxanes-based chemotherapy to relapse as a definition. Furthermore, we demonstrated that this definition of early relapse is not biased by the potential missing data for the date of completion of neo/adjuvant therapy, by conducting a sensitivity analysis using an interval of 6 to 18 months from the diagnosis of the primary tumor to the metastatic diagnosis an alternate definition of early relapse (patients who relapsed from 0 to 6 months are excluded as considered de novo metastatic in this case). Although this cohort is retrospective, these data remain relevant and timely as patients with such early relapsed mTNBC were excluded from many recent registration trials (6,8).

Despite our efforts, our study has limitations and biases inherent to the real-world methodology. In the ESME-based analyses, TNBC patients were defined using the threshold of 10% for hormone receptors expression, compared to the North American threshold of 1%. This different classification should not affect survival as patients with low HR (1-10%) were few (0.4% of the cohort, data not

shown) and their prognosis overlaps with TNBC (27,28). The selection criteria of the ESME database included only patients who started a systemic treatment at the metastatic stage. As the ESME cohort focuses on patients with metastatic breast cancer, information on localized stage is often lacking, such as initial staging, specific treatment received such as platinum and biology as well as socioeconomic data, which limits analysis of predictors from early relapse. However, these factors have already been widely demonstrated in two previous cohorts (29,30). Also, several data, especially pathological and biological, are not present in ESME. The lack of genomic data, PDL1 expression, androgen receptor expression, or pathologic response to neoadjuvant therapy (pCR) and the large proportion of patients who did not undergo genetic testing because of the absence of anti-PARP approval during the inclusion period hypothesis generation but would not impact the present findings. In addition, the selection of our population creates a risk of selection bias. Patients for whom the date of completion of neoadjuvant chemotherapy was not specified have similar characteristics to our population and shall not lead to bias. However, patients who did not receive neoadjuvant chemotherapy slightly differ from our population (older, more grades I and II among others), but their small size should not alter our conclusions (Supplementary Table 1). Furthermore, the ESME database, by definition, excludes patients who are not receiving systemic treatment at the metastatic stage and who have a compromised general condition that does not allow for such treatments. This could potentially lead to a slight overestimation of OS without altering our conclusions. Finally, in our analysis, we did not observe any difference in the inclusion of early and late relapsed TNBC patients in first-line metastatic trials. This is likely because modern trials are not accounted for in the inclusion period of our cohort.

### **Conclusion**

In this large-scale real-life study evaluating of 881 women with early relapsed metastatic TNBC, overall survival was less than one year. All survival outcomes were considerably lower than those of women with later relapses, revealing that these patients have highly "difficult-to-treat" disease. Early relapsed metastatic TNBC represents a major unmet medical need for which effective therapeutic strategies and dedicated clinical trials are urgently required.

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### Authors contributions

Conceptualization: TG, AA, BP, SD; Formal analysis: TG and AA; Methodology: All authors; Project administration: TG; Software: AA; Supervision: SD; Validation SD; Writing - original draft: TG, AA, SD; Writing - review & editing: All authors

### References

1. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin*. 2021;71(3):209-249. doi:<https://doi.org/10.3322/caac.21660>
2. Bianchini G, De Angelis C, Licata L, Gianni L. Treatment landscape of triple-negative breast cancer — expanded options, evolving needs. *Nat Rev Clin Oncol*. Published online November 9, 2021:1-23. doi:10.1038/s41571-021-00565-2
3. Dent R, Hanna WM, Trudeau M, Rawlinson E, Sun P, Narod SA. Pattern of metastatic spread in triple-negative breast cancer. *Breast Cancer Res Treat*. 2009;115(2):423-428. doi:10.1007/s10549-008-0086-2
4. Deluche E, Antoine A, Bachelot T, et al. Contemporary outcomes of metastatic breast cancer among 22,000 women from the multicentre ESME cohort 2008-2016. *Eur J Cancer Oxf Engl 1990*. 2020;129:60-70. doi:10.1016/j.ejca.2020.01.016
5. Grinda T, Antoine A, Jacot W, et al. Evolution of overall survival and receipt of new therapies by subtype among 20 446 metastatic breast cancer patients in the 2008-2017 ESME cohort. *ESMO Open*. 2021;6(3). doi:10.1016/j.esmoop.2021.100114
6. Miles D, Gligorov J, André F, et al. Primary results from IMpassion131, a double-blind, placebo-controlled, randomised phase III trial of first-line paclitaxel with or without atezolizumab for unresectable locally advanced/metastatic triple-negative breast cancer. *Ann Oncol*. 2021;32(8):994-1004. doi:10.1016/j.annonc.2021.05.801

7. Schettini F, Venturini S, Giuliano M, et al. Multiple Bayesian network meta-analyses to establish therapeutic algorithms for metastatic triple negative breast cancer. *Cancer Treat Rev.* 2022;111:102468. doi:10.1016/j.ctrv.2022.102468
8. Cortes J, Rugo HS, Cescon DW, et al. Pembrolizumab plus Chemotherapy in Advanced Triple-Negative Breast Cancer. *N Engl J Med.* 2022;387(3):217-226. doi:10.1056/NEJMoa2202809
9. Bardia A, Hurvitz SA, Tolaney SM, et al. Sacituzumab Govitecan in Metastatic Triple-Negative Breast Cancer. *N Engl J Med.* Published online April 21, 2021. doi:10.1056/NEJMoa2028485
10. Robson M, Im SA, Senkus E, et al. Olaparib for Metastatic Breast Cancer in Patients with a Germline BRCA Mutation. *N Engl J Med.* 2017;377(6):523-533. doi:10.1056/NEJMoa1706450
11. Litton JK, Rugo HS, Ettl J, et al. Talazoparib in Patients with Advanced Breast Cancer and a Germline BRCA Mutation. *N Engl J Med.* 2018;379(8):753-763. doi:10.1056/NEJMoa1802905
12. Conte P, Guarneri V, Bengala C. Evolving Nonendocrine Therapeutic Options for Metastatic Breast Cancer: How Adjuvant Chemotherapy Influences Treatment. *Clin Breast Cancer.* 2007;7(11):841-849. doi:10.3816/CBC.2007.n.048
13. Vasseur A, Carton M, Guiu S, et al. Efficacy of taxanes rechallenge in first-line treatment of early metastatic relapse of patients with HER2-negative breast cancer previously treated with a (neo)adjuvant taxanes regimen: A multicentre retrospective observational study. *The Breast.* 2022;0(0). doi:10.1016/j.breast.2022.07.014
14. Schmid P, Rugo HS, Adams S, et al. Atezolizumab plus nab-paclitaxel as first-line treatment for unresectable, locally advanced or metastatic triple-negative breast cancer (IMpassion130): updated efficacy results from a randomised, double-blind, placebo-controlled, phase 3 trial. *Lancet Oncol.* 2020;21(1):44-59. doi:10.1016/S1470-2045(19)30689-8
15. Brufsky A, Kim SB, Zvirbule Ž, et al. A phase II randomized trial of cobimetinib plus chemotherapy, with or without atezolizumab, as first-line treatment for patients with locally advanced or metastatic triple-negative breast cancer (COLET): primary analysis. *Ann Oncol.* 2021;0(0). doi:10.1016/j.annonc.2021.01.065
16. Dent R, Oliveira M, Isakoff SJ, et al. Final results of the double-blind placebo-controlled randomized phase 2 LOTUS trial of first-line ipatasertib plus paclitaxel for inoperable locally advanced/metastatic triple-negative breast cancer. *Breast Cancer Res Treat.* 2021;189(2):377-386. doi:10.1007/s10549-021-06143-5
17. Kim SB, Dent R, Im SA, et al. Ipatasertib plus paclitaxel versus placebo plus paclitaxel as first-line therapy for metastatic triple-negative breast cancer (LOTUS): a multicentre, randomised, double-blind, placebo-controlled, phase 2 trial. *Lancet Oncol.* 2017;18(10):1360-1372. doi:10.1016/S1470-2045(17)30450-3
18. Yardley DA, Coleman R, Conte P, et al. nab-Paclitaxel plus carboplatin or gemcitabine versus

- gemcitabine plus carboplatin as first-line treatment of patients with triple-negative metastatic breast cancer: results from the tnAcity trial. *Ann Oncol.* 2018;29(8):1763-1770. doi:10.1093/annonc/mdy20119.
19. Booth CM, Karim S, Mackillop WJ. Real-world data: towards achieving the achievable in cancer care. *Nat Rev Clin Oncol.* 2019;16(5):312-325. doi:10.1038/s41571-019-0167-7
20. Pérol D, Robain M, Arveux P, et al. The ongoing French metastatic breast cancer (MBC) cohort: the example-based methodology of the Epidemiological Strategy and Medical Economics (ESME). *BMJ Open.* 2019;9(2):e023568. doi:10.1136/bmjopen-2018-023568
21. Gobbini E, Ezzalfani M, Dieras V, et al. Time trends of overall survival among metastatic breast cancer patients in the real-life ESME cohort. *Eur J Cancer.* 2018;96:17-24. doi:10.1016/j.ejca.2018.03.015
22. Elm E von, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol.* 2008;61(4):344-349. doi:10.1016/j.jclinepi.2007.11.008
23. MacGrogan G, Mathieu MC, Poulet B, et al. [Pre-analytical stage for biomarker assessment in breast cancer: 2014 update of the GEFPICS' guidelines in France]. *Ann Pathol.* 2014;34(5):366-372. doi:10.1016/j.annpat.2014.08.017
24. Maran-Gonzalez A, Franchet C, Duprez-Paumier R, et al. [GEFPICS' guidelines for management of breast cancer tissue samples in the neoadjuvant setting]. *Ann Pathol.* 2019;39(6):383-398. doi:10.1016/j.annpat.2019.04.004
25. Wolff AC, Hammond MEH, Allison KH, et al. Human Epidermal Growth Factor Receptor 2 Testing in Breast Cancer: American Society of Clinical Oncology/College of American Pathologists Clinical Practice Guideline Focused Update. *Arch Pathol Lab Med.* 2018;142(11):1364-1382. doi:10.5858/arpa.2018-0902-SA
26. Steffen M. Universalism, Responsiveness, Sustainability — Regulating the French Health Care System. *N Engl J Med.* 2016;374(5):401-405. doi:10.1056/NEJMp1504547
27. Fujii T, Kogawa T, Dong W, et al. Revisiting the definition of estrogen receptor positivity in HER2-negative primary breast cancer. *Ann Oncol.* 2017;28(10):2420-2428. doi:10.1093/annonc/mdx397
28. Villegas SL, Nekljudova V, Pfarr N, et al. Therapy response and prognosis of patients with early breast cancer with low positivity for hormone receptors - An analysis of 2765 patients from neoadjuvant clinical trials. *Eur J Cancer Oxf Engl 1990.* 2021;148:159-170. doi:10.1016/j.ejca.2021.02.020
29. Asad S, Barcenas CH, Bleicher RJ, et al. Sociodemographic Factors Associated With Rapid Relapse in Triple-Negative Breast Cancer: A Multi-Institution Study. *J Natl Compr Canc Netw.* 2021;1(aop):1-8. doi:10.6004/jnccn.2020.7659

30. Obeng-Gyasi S, Asad S, Fisher JL, Rahurkar S, Stover DG. Socioeconomic and Surgical Disparities are Associated with Rapid Relapse in Patients with Triple-Negative Breast Cancer. *Ann Surg Oncol*. Published online February 14, 2021. doi:10.1245/s10434-021-09688-3

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### Authors contributions

Conceptualization: TG, AA, BP, SD; Formal analysis: TG and AA; Methodology: All authors; Project administration: TG; Software: AA; Supervision: SD; Validation SD; Writing - original draft: TG, AA, SD; Writing - review & editing: All authors

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## Declaration of Competing Interest

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

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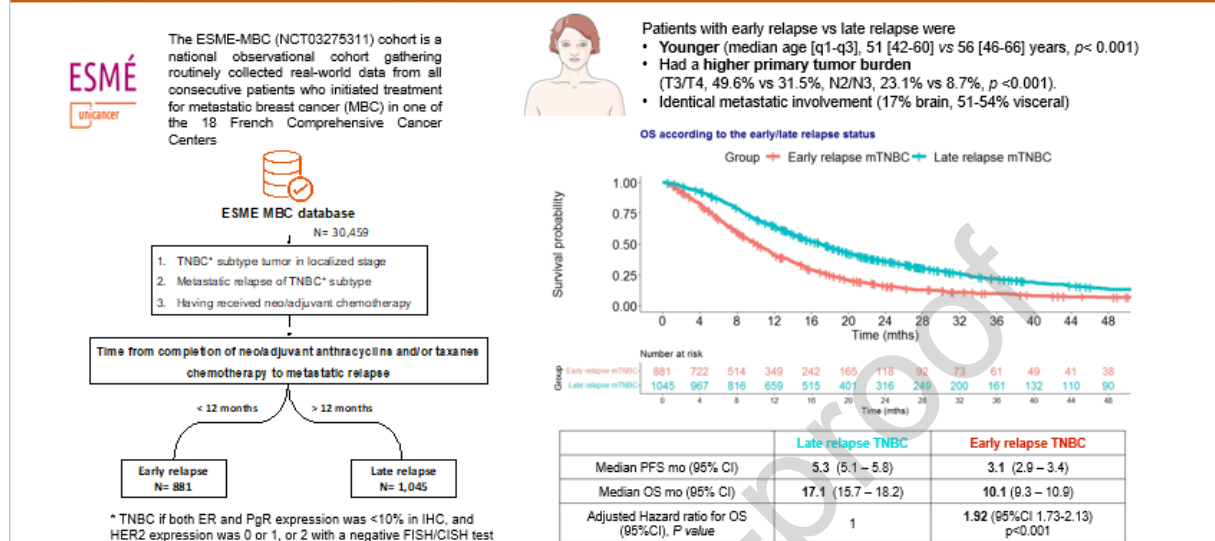
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## Graphical abstract

## Current and evolutionary analysis of early relapsed metastatic triple negative breast cancer in the Nationwide ESMÉ cohort

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## Highlights

- Patients with early relapse represent nearly 1/2 of the relapsing metastatic TNBC.
- Early relapsers were younger and had a higher tumor burden at primary diagnosis.
- Median OS of early relapsers was < 1 year (10.1 months vs 17.1 for late relapsers).
- The median PFS1 of early relapsers was lower than late relapsers (3.1 vs 5.3 mo).
- Early relapse is an independent prognostic factor for OS (HR 1.92(1.73-2.13)  $p < 0.001$ )
- Women with early relapsed metastatic TNBC represent a highly unmet medical need.