

Disparities in ST-elevation myocardial infarction diagnosis and management among patients with mental health conditions

PSYchological Factors Affecting STEMI Treatment: the PSYFAST study

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Aims

Patients with mental health conditions (MHCs) experience delayed diagnosis and management. We aimed to assess whether these patients had longer treatment delays and poorer outcomes despite a dedicated ST-elevation myocardial infarction (STEMI) fast-track protocol.

Methods and results

We analysed data from EVALFAST prospective registry of confirmed STEMI patients admitted directly to the catheterization laboratory at Fribourg Hospital since June 2008. Patients were classified into MHC cohort if their electronic health record documented any MHC at STEMI diagnosis. The primary endpoint was time from the first medical contact (FMC) to diagnosis. Secondary endpoints included FMC-to-balloon time, infarct size (peak CK-MB), and 30-day and 5-year major adverse cardiac and cerebrovascular events (MACCE). We used generalized linear models adjusted for demographics, risk factors, and presentation mode, and Cox regression for survival analyses. Among 1208 patients (excluding cardiac arrests), 147 (12.1%) had documented MHC. The MHC cohort had more women (36.7 vs. 23.3%; $P = 0.002$) and hypertension (57.8 vs. 47.8%; $P = 0.03$). After adjustment, FMC-to-diagnosis time was significantly longer in MHC patients [$+16.43$ min; 95% confidence interval (CI) $+4.19$ to $+28.68$; $P = 0.009$], resulting in prolonged FMC-to-balloon time ($+18.63$ min; 95% CI $+4.86$ to $+32.39$; $P = 0.008$). Diagnosis-to-balloon time did not differ ($P = 0.420$). Delays were pronounced among patients self-presenting to emergency departments ($P = 0.002$). Mental health condition patients had larger infarct sizes (peak CK-MB $+71.3$ U/L; 95% CI $+18.0$ to $+124.6$; $P = 0.009$) and higher risk of 30-day MACCE [adjusted hazard ratio (HR) 1.82; 95% CI 1.05–3.17; $P = 0.034$] and 5-year cardiovascular death (adjusted HR 2.04; 95% CI 1.18–3.55; $P = 0.011$).

Conclusion

Among patients presenting with STEMI, being labelled with an MHC was linked with increased delays in early management, leading to greater infarct size and higher risk of adverse cardiovascular events. Mental health conditions were associated with increased long-term years cardiovascular death.

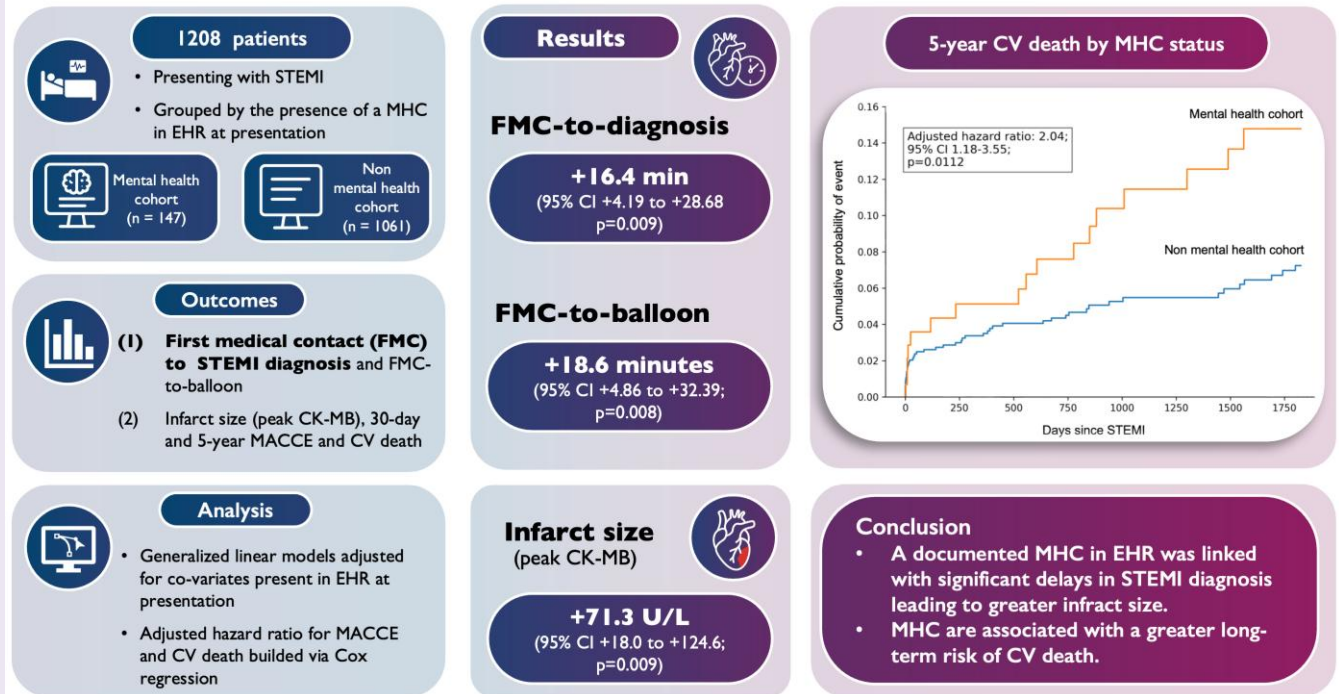
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Graphical abstract

Disparities in STEMI diagnosis and management among patients with mental health conditions

Do patients with STEMI with a documented mental health condition (MHC) in EHR have longer treatment delays?



Keywords

STEMI • Mental health • Healthcare disparities • Diagnostic delay • Cardiovascular outcomes

Key Learning Points

What is already known:

- Patients with mental health conditions (MHCs) experience worse cardiovascular outcomes and may face delays in acute care.
- Timely ST-elevation myocardial infarction (STEMI) diagnosis and intervention are critical for reducing myocardial injury and mortality.
- Healthcare disparities and implicit bias can affect the quality of care for patients with MHCs.

What this study adds:

- Mental health conditions documented in medical records were associated with significant delays in STEMI diagnosis, particularly for patients self-presenting to emergency departments.
- These diagnostic delays resulted in larger infarct sizes and were linked with increased short- and long-term cardiovascular mortality.
- No delays occurred after STEMI diagnosis, suggesting bias occurs at the initial triage rather than during interventional treatment.

Introduction

Cardiovascular diseases, particularly ST-elevation myocardial infarction (STEMI), remain the leading cause of morbidity and mortality worldwide. Timely diagnosis and intervention, especially minimizing symptom-to-balloon time, are critical to improving outcomes.^{1,2} Despite advances in fast-track systems for STEMI management,

disparities persist among specific patient groups, including those with mental health conditions (MHCs), who often experience delays in care.³⁻⁶

Previous research suggests that patients with documented histories of MHC are at increased risk of diagnostic and treatment delays,³ are more likely to present with atypical symptoms and to have their complaints misattributed as psychosomatic or anxiety-related, resulting in

delayed triage and reperfusion interventions.^{7,8} In STEMI, such delays can substantially prolong ischaemic time, which is directly correlated with poorer clinical outcomes.^{6,9}

Systemic barriers, including fragmented care between MHC and cardiovascular specialties and implicit biases among healthcare providers, further exacerbate delays. Studies also highlight that patients with MHC are less likely to receive time-sensitive procedures such as prompt catheterization or revascularization.^{7,10}

The present study aimed to determine whether patients with documented MHC in electronic health records (EHRs) at the time of STEMI presentation experience prolonged delays in treatment compared with those without such conditions. These delays could potentially lead to greater infarct size and poorer outcomes. We also sought to identify patient- and system-level factors contributing to these delays. By examining treatment timelines and underlying disparities, we sought to provide evidence for targeted interventions that could reduce delays and enhance the equity of care for this vulnerable patient population.

Methods

Study design, population, and data collection

EvalFAST is a prospective single-centre registry initiated in June 2008 at the University and Hospital Fribourg, Switzerland, as part of a structured STEMI fast-track network. Data were collected retrospectively from 2008 to 2009, then prospectively from 2010 onwards. All patients with a suspected diagnosis of STEMI referred via the local STEMI network were eligible for inclusion. Patients were excluded if the final diagnosis was not STEMI, if they were unable or unwilling to provide written informed consent, or if follow-up data were unavailable.

The follow-up was conducted at 1 month, 1 year, and then annually up to 5 years through telephone interviews or outpatient clinic visits. Ethical approval was obtained from the local ethics committee (protocol no. 001-R-CER-FR), and written informed consent was obtained from all participants. The registry is registered in ClinicalTrials.gov (number NCT04185285). For the purposes of this analysis, data were extracted for all patients enrolled between June 2008 and November 2024.

STEMI Network Fribourg

The STEMI Fast Track Network Fribourg was started in June 2008. It includes one catheterization laboratory facility providing 24/7 primary percutaneous coronary intervention (PCI) to six referring hospitals, covering a population of 320 000 over 1600 km². In cases of symptoms suggestive of myocardial infarction and typical electrocardiogram (ECG) signs [ST elevation, presumed new left bundle branch block, or ST depression in leads V1–V3 at first medical contact (FMC)], STEMI was to be suspected, and the fast-track protocol initiated. The referring hospital, ambulance emergency medical service, or general practitioner contacted the on-call intensive care physician, who triaged and confirmed or ruled out the diagnosis of STEMI in collaboration with the on-call interventional cardiologist.

Patients with confirmed STEMI were transferred directly to the catheterization laboratory of the University and Hospital Fribourg, bypassing the emergency room (ER). Medical treatment was administered as soon as STEMI was suspected.

Primary PCI procedures were performed according to contemporary ESC guidelines throughout the study period. From 2008 to 2014, interventions followed the 2008 ESC recommendations for the management of acute myocardial infarction in patients presenting with persistent ST-segment elevation.¹¹ For patients enrolled after 2014, procedures were adapted to follow the 2012 ESC STEMI guidelines and subsequent updates. For patients enrolled after 2023, procedures were adapted to follow the 2023 ESC ACS guidelines and subsequent updates.¹ The evolution of antiplatelet therapy during the study period reflected major trial evidence: clopidogrel was the standard P2Y₁₂ inhibitor from 2008 to 2009, after which ticagrelor and prasugrel became preferentially prescribed until the end of the trial. Manual thrombectomy was performed whenever deemed necessary by the interventional cardiologist.¹² Despite these evolving technical aspects, the core principle of minimizing time-to-reperfusion and the

fast-track network structure remained consistent throughout the 16-year study period.

Study definitions and endpoints

The FMC-to-diagnosis interval was measured from FMC to confirmation of STEMI and activation of the fast-track protocol to catheterization laboratory. Other intervals included fast-track time interval (with diagnosis-to-catheterization laboratory arrival and catheterization laboratory-to-balloon), FMC-to-balloon, and symptoms-to-FMC defined by the patient's reported onset of chest pain. Death was classified as cardiovascular (CV) or non-CV according to Academic Research Consortium definitions.¹³

Patients whose EHR at the time of STEMI diagnosis mentioned any form of MHC were assigned to the MHC cohort, while those without such mentions were placed in the non-MHC cohort. The complete list of what was considered an MHC at the time of diagnosis according to International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)¹⁴ is available in [Supplementary material online, Tables S1 and S2](#). The only exclusion criteria was presentation to FMC in cardiac arrest due to the absolute urgency of this condition, which, in our opinion, made the analysis of care bias less relevant. In a secondary analysis, any mention of alcohol use disorder at the time of STEMI diagnosis formed an alcohol use disorder cohort, whereas those without such mention constituted the non-alcohol use disorder cohort.

Endpoints

The primary endpoint was the FMC-to-diagnosis time. Secondary endpoints included FMC-to-balloon and door-to-balloon times and the aforementioned intervals, as well as 30-day and 5-year major adverse cardiac and cerebrovascular events (MACCE), defined as a composite of cardiac death, stroke, non-fatal myocardial infarction, and any unplanned revascularization. Secondary endpoints also encompassed the individual MACCE components, non-cardiovascular death, and peak levels of creatine kinase (CK) and CK to muscle brain (CK-MB). Creatine kinase to muscle brain was chosen as the primary biomarker for infarct size assessment due to consistent assay methodology and unchanged cut-off values throughout the entire 16-year study period, whereas troponin assays underwent multiple changes in both methodology and cut-off values in line with evolving guidelines, which would have introduced significant heterogeneity and compromised the validity of comparisons across the study cohort. Left ventricular ejection fraction (LVEF) was assessed by transthoracic echocardiography on Day 2 post-PCI during the index hospitalization.

Statistical analysis

Patients were stratified into MHC and non-MHC cohorts based on their EHR classification at the time of STEMI diagnosis. Generalized linear models (GLMs) were built to compare time intervals (in minutes) and other continuous endpoints between cohorts. Models were adjusted for all clinically relevant covariates documented in the EHR at the moment of presentation. Adjusted mean differences with 95% confidence intervals (CIs) and *P*-values were reported. Event-time outcomes were assessed using the Kaplan–Meier curves and Cox proportional-hazards models; proportional hazards assumptions were verified using Schoenfeld residuals. We conducted sensitivity analyses by varying the set of covariates included in the model, adjusting for no confounders, a minimal set, a cardiovascular risk factors set, coronary revascularization set, a substance abuse history set, and all the clinically plausible confounders together.

Statistical significance was set at two-sided *P* < 0.05. Missing data were handled by case-wise deletion for missing outcomes, and mean imputation (continuous variables) or mode imputation (categorical variables) for missing covariates; sensitivity analyses tested alternative imputation strategies. Analyses were performed using Python 3.13 (NumPy, pandas, statsmodels, scikit-learn, lifelines, SciPy) with PostgreSQL 14.15 via psycopg2 in Visual Studio Code 1.95.

Results

Among 1330 patients in the EvalFAST registry, 122 (9.2%) were excluded because they presented a cardiac arrest presentation. Among

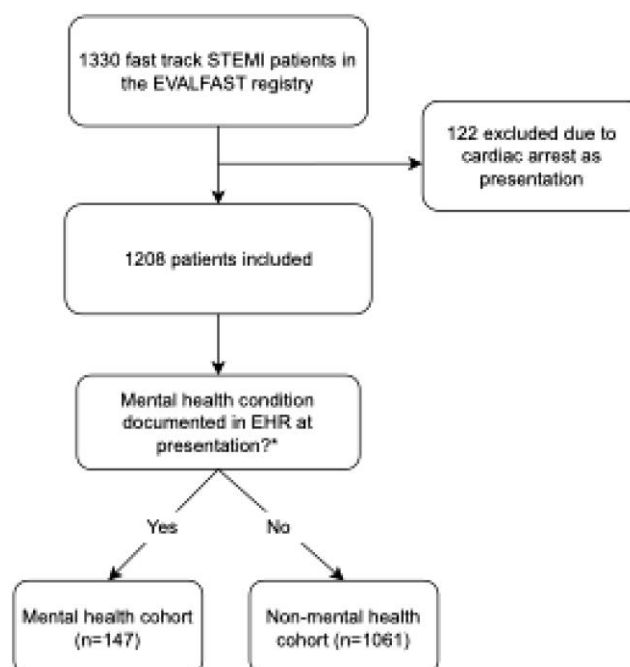


Figure 1 Flowchart of patient's inclusion and categorization. *See [Supplementary material online, Table S1](#) for the complete list. EHR, electronic health record; STEMI, ST-elevation myocardial infarction.

Table 2 Key times interval between the mental health and non-mental health cohort

Time variable	Non-mental health cohort (n = 1061)	Mental health cohort (n = 147)	P-value
Symptoms-to-FMC, min	146.28 ± 146.07	115.87 ± 134.63	0.135
FMC-to-diagnosis, min	40.21 ± 36.93	59.10 ± 86.34	0.009
Diagnosis-to-cathlab, min	38.16 ± 18.50	39.35 ± 20.20	0.375
Cathlab-to-balloon, min	18.93 ± 11.92	19.33 ± 8.69	0.931
FMC-to-balloon, min	97.30 ± 44.88	117.78 ± 89.39	0.008
Diagnosis-to-balloon, min	57.09 ± 21.55	58.68 ± 21.58	0.420
Symptoms-to-balloon, min	243.16 ± 158.44	232.46 ± 161.42	0.613

Values are mean ± standard deviation.
cathlab, catheterization laboratory; FMC, first medical contact.

3.17; $P = 0.034$), primarily driven by non-significant trends in stroke (unadjusted HR 1.73; 95% CI 0.58–5.18; $P = 0.326$; adjusted model did not converge) and unplanned revascularization (unadjusted HR 1.41; 95% CI 0.59–3.40; $P = 0.441$; adjusted HR 1.36; 95% CI 0.56–3.31; $P = 0.501$) ([Figure 3](#)). At 5 years, the unadjusted HR for MACCE was 1.43 (95% CI 1.04–1.97; $P = 0.028$) and the adjusted HR was 1.39 (95% CI 1.01–1.92; $P = 0.045$), mainly driven by cardiovascular death (unadjusted HR 2.01; 95% CI 1.16–3.49; $P = 0.013$; adjusted HR 2.04; 95% CI 1.18–3.55; $P = 0.011$) ([Figure 4](#)). No significant differences emerged in 5-year myocardial infarction (unadjusted HR 1.11; 95% CI 0.60–2.05; $P = 0.743$; adjusted $P = 1.00$), unplanned revascularization (unadjusted HR 1.19; 95% CI 0.78–1.83; $P = 0.426$; adjusted $P = 0.627$), or stroke (unadjusted HR 1.35; 95% CI 0.66–2.78; $P = 0.415$; adjusted $P = 0.422$). Non-cardiovascular death did not differ between the two groups (unadjusted HR 1.52; 95% CI 0.66–3.53; $P = 0.325$; adjusted

$P = 0.368$). Examining the impact of diagnostic delay and infarct size on MACCE showed that adjustment for time-to-diagnosis alone yielded HR 1.08 (95% CI 0.71–2.71; $P = 0.02$), and adjustment for infarct size alone yielded HR 1.48 (95% CI 1.07–2.04; $P = 0.02$).

Secondary analysis

Subgroup analysis by mode of arrival (ambulance vs. self-presentation) indicated that self-presenting ER patients in the MHC cohort had a significantly prolonged FMC-to-diagnosis time (adjusted mean difference, +58.08; 95% CI +20.64 to +95.52; $P = 0.002$), whereas no significant differences were observed in the ambulance subgroup (adjusted mean difference +9.45 min; 95% CI –3.44 to +22.33; $P = 0.15$). Among women in the MHC cohort, there was no significant difference in FMC-to-diagnosis time compared with men (adjusted mean difference

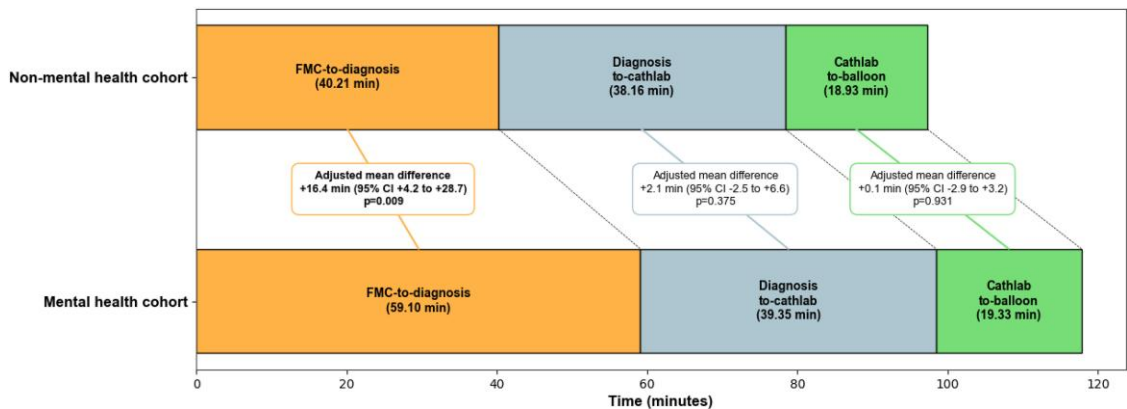


Figure 2 Schematic of time intervals from first medical contact to balloon in patients with and without mental health conditions. Comparison of three key time intervals in the ST-elevation myocardial infarction care pathway between the non-mental health cohort (top) and the mental health cohort (bottom): first medical contact to diagnosis (first block), diagnosis to catheterization laboratory (second block); catheterization laboratory to balloon (third block). Adjusted mean differences (with 95% confidence intervals and *P*-values) are displayed in call-out boxes for each interval. FMC, first medical contact; STEMI, ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; cathlab, catheterization laboratory; CI, confidence interval.

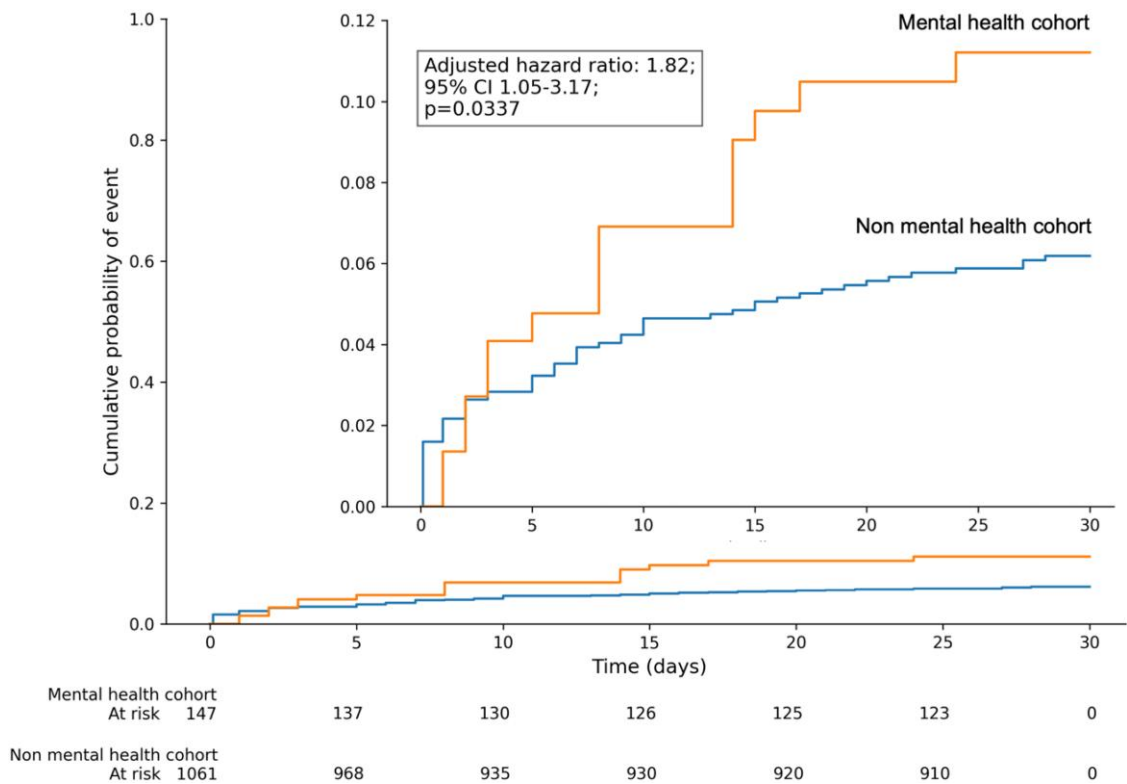


Figure 3 Kaplan–Meier curves for 30-day major adverse cardiac and cerebrovascular events by mental health status. Kaplan–Meier survival estimates comparing the non-mental health cohort with the mental health cohort. Major adverse cardiac and cerebrovascular events was defined as a composite of cardiovascular death, stroke, myocardial infarction, and unplanned revascularization. MACCE, major adverse cardiac and cerebrovascular events.

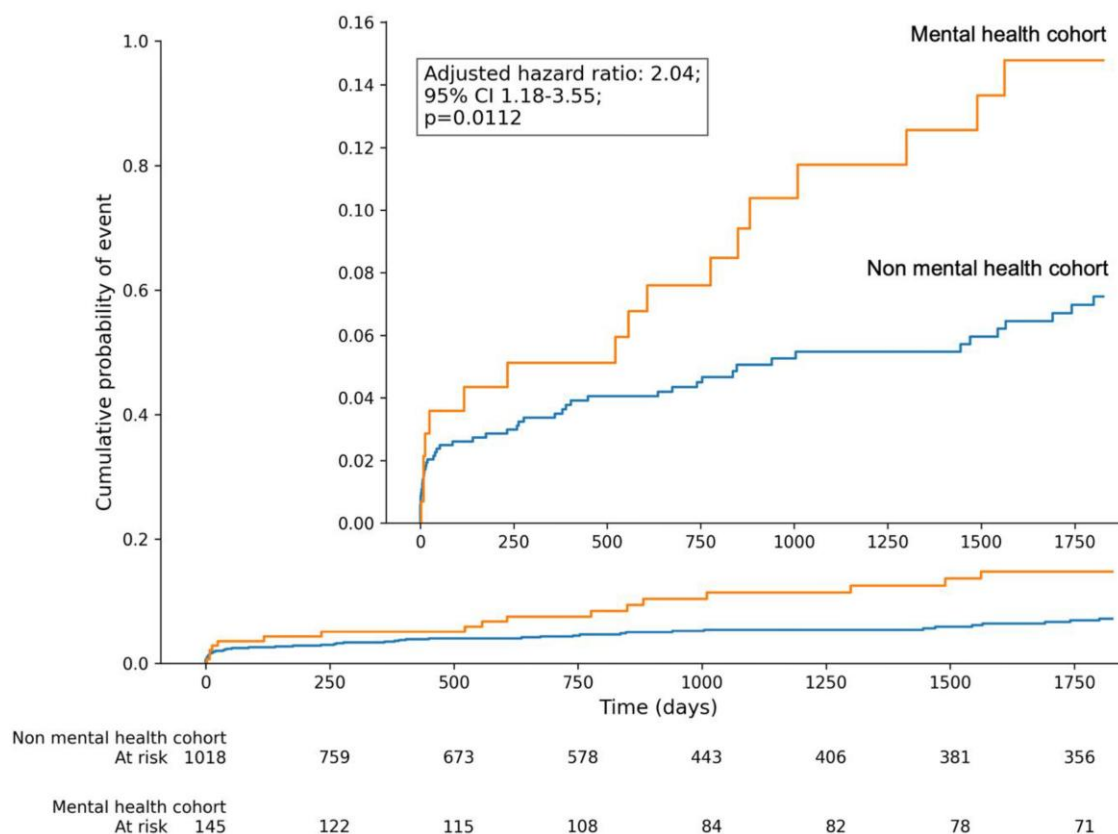


Figure 4 Kaplan–Meier curve for 5-year cardiovascular death by mental health status. Kaplan–Meier survival estimates comparing the non-mental health cohort with the mental health cohort. There were 43/1061 (4.05%) vs. 2/147 (1.36%) missing data, mainly patients living in another country.

+11.44 min; 95% CI –10.88 to +33.77; $P = 0.315$). In the secondary analysis focusing on alcohol use, the adjusted mean difference in FMC-to-diagnosis time was +32.67 min (95% CI +1.38 to +63.97; $P = 0.041$) in patients with alcohol use disorder, with a non-significant adjusted mean difference for FMC-to-balloon of +29.24 min (95% CI –5.74 to +64.2; $P = 0.101$). Full results of subgroup analyses are available in [Supplementary material online, Table S3](#). Complete sensitivity analysis for continuous and survival endpoints are available in [Supplementary material online, Tables S4 and S5](#).

Discussion

This study demonstrated the following results: STEMI patients with documented MHC experienced (i) significant delays from FMC to STEMI diagnosis, (ii) prolongation of FMC-to-balloon time, (iii) increased infarct size, and (iv) worse short- and long-term outcomes. To our knowledge, this is the first study indicating that early diagnostic delays in this patient population may be linked to human bias and are associated with higher infarct size and worse short- and long-term outcomes.

Our findings align with prior research showing that MHC can influence both the timeliness and quality of cardiovascular care,^{3,6,15} indicating that the primary barrier is at the initial recognition stage rather than during interventional treatment once STEMI is diagnosed. The reasons for these delays are likely multifactorial. Patients with MHC may

present with atypical symptoms, and their complaints might be misattributed to anxiety or psychosomatic issues.^{7,8,16–18} Such mislabelling arises from implicit biases and cognitive heuristics,^{19,20} leading to delays in urgent investigations such as ECG. Similar phenomena have been reported in stroke care¹⁰ and emergency surgery for perforated ulcers,²¹ contributing to worse outcomes. Patients with schizophrenia or bipolar disorder frequently have undiagnosed cardiovascular disease before cardiovascular death,⁸ and those with mood or anxiety disorders are often underdiagnosed at the primary care level.^{22,23} Notably, we observed no differences in diagnosis-to-balloon time, suggesting that the issue may indeed lie with clinicians' bias towards MH disorders.

We observed a correlation between early diagnostic delays and increase in biological markers indicating greater infarct size and long-term adverse outcomes. Indeed, patients with MHC exhibited significantly higher peak CK-MB levels, suggesting more extensive myocardial necrosis. These findings align with the literature highlighting that longer ischaemic times lead to worse infarct-related outcomes, with the symptom-to-balloon interval serving as a critical predictor of left ventricular function.^{24,25} Although door-to-balloon time improvements are often emphasized, our results underscore the importance of the entire care pathway, starting from FMC, as early delays ultimately translate into greater myocardial injury.

Furthermore, we observed an increased incidence of MACCE at both 30-day and 5 years among patients with MHC. Interestingly, in this patient population, only CV death was higher and not non-CV death, suggesting that these results are less likely to be driven by the

comparison of two inherently different patient populations. The baseline characteristics only differed with hypertension and gender, and the model remained significant after adjustment for those covariates. Our overall findings are consistent with previous evidence that MHC can predict worse cardiovascular outcomes.^{6,8–10} Mental illnesses have been associated with a higher likelihood of missed diagnoses,³ and lower adherence to secondary prevention measures.²⁶ Such cumulative factors could explain the sustained vulnerability observed in our cohort, including increased cardiovascular death over the long term.

Interestingly, we did not find differences in the interval from symptom onset to FMC. This contrasts with studies showing that psychological factors such as misinterpretation of symptoms, denial, and anxiety can delay help-seeking.^{4,5,27–30} It is possible that education within the STEMI network mitigates these prehospital delays or that MHC in our cohort did not substantially alter initial patient-driven decision-making. Similarly, while previous studies found that concerns like troubling others or embarrassment may delay presentation,^{4,28} these social factors may have been less salient in our specific setting.

In our study, the presence of MHC did not cause additional delays for women, which is reassuring given well-documented sex-related disparities in cardiovascular care.³¹ However, our findings underscore a fundamental weakness in current healthcare delivery systems: the presence of MHC in a patient's EHR appears to systematically alter clinical decision-making, even in time-critical situations like STEMI. The pronounced delays observed in self-presenting emergency department patients, but not in ambulance arrivals, suggest that when clinicians have both access to psychiatric history and discretionary decision-making power, implicit biases influence care delivery. This is not a story about biological differences in STEMI presentation, but rather about how healthcare systems fail to provide equitable care.

The role of EHR access deserves particular scrutiny. While comprehensive medical histories are essential for good clinical care, our data suggest that visible psychiatric diagnoses may prime clinicians towards psychological rather than cardiac interpretations of symptoms. Emergency physicians, who typically have fuller EHR access than paramedics, showed greater diagnostic delays for MHC patients. This raises challenging questions about information design in acute care setting: how can we preserve important medical information while preventing it from triggering cognitive biases that delay life-saving interventions?

These findings demand a comprehensive response at multiple levels. First, permanent education programmes for all healthcare professionals must address implicit bias, diagnostic overshadowing, and the specific challenges of caring for patients with MHC. This cannot be a one-time training but must be integrated into ongoing professional development, with regular assessment of outcomes. Second, systemic reforms are needed: standardized protocols mandating immediate ECG for all chest pain presentations regardless of psychiatric history, quality metrics that track diagnostic times stratified by MHC status, and potentially, modifications to how psychiatric information is displayed during acute triage situations.

The causal pathway suggested by our data, from EHR documentation of MHC to clinical bias to diagnostic delay to increased myocardial damage to worse outcomes, represents a preventable cascade of healthcare failure. While factors such as patient anxiety^{32,33} and chronic stress-related cardiovascular vulnerability^{34–36} may contribute, the dominant signal in our data points to systematic discrimination at the point of clinical assessment. This is not merely an issue of individual clinician behaviour but reflects deeper structural problems in how healthcare systems approach patients with MHCs.

Limitations

This study has several limitations. First, it was conducted at a single centre, limiting generalizability. Second, we used CK-MB rather than troponin for infarct size assessment due to assay consistency throughout the

16-year study period; however, we acknowledge troponin is currently the preferred biomarker. Third, echocardiographic assessment was only available from the acute phase rather than in long-term follow-up, which may not fully reflect final infarct size and ventricular remodelling. Fourth, we lack data on medication adherence, particularly for antithrombotic therapy and secondary prevention medications, which may have influenced long-term outcomes. Fifth, the extended study period (2008–24) spans significant changes in both interventional techniques and societal attitudes towards mental health, which we could not fully account for in our analysis. Finally, subgroup analyses involved small sample sizes requiring cautious interpretation.

Conclusion

Among patients presenting with STEMI, the presence of MHC in EHR was associated with significant delays in early management, higher infarct size, and an increased short- and long-term risk of adverse cardiovascular events, including death. Acknowledging these disparities and implementing structured, evidence-based strategies could help ensure that all patients receive timely and equitable care, regardless of their mental health status.

Supplementary material

Supplementary material is available at *European Heart Journal—Quality of Care and Clinical Outcomes* online.

Author contributions

Dorian Garin (Writing—original draft [lead], Methodology [equal], Data curation [equal], Data analysis [lead]), Erik Mendola (validation [lead], Writing—review & editing [equal]), Yannick Faucherre (Data curation [lead], Formal analysis [equal]), Giacomo M. Cioffi (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Thais Pittet (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Selma T. Cook (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Mario Togni (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Julius Jelisejevas (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Wesley Bennar (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Mario Togni (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Pascal Meier (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Peter Wenaweser (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Serban Puricel (Writing—review & editing [equal], Data curation [equal], Supervision [lead]), Stéphane Cook (Writing—review & editing [lead], Supervision [lead]), and Sonja Lehmann (Conceptualization [lead], Investigation [lead], Methodology [equal], Supervision [equal])

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Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

The raw data supporting the conclusions of this article will be made available by the authors on reasonable request.

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