Prospective evaluation of lipid management following acute coronary syndrome in non-Western countries

Ann Marie Navar MD, PhD1,2 | Simon T. Matskeplishvili MD, PhD, FESC, FACC3 | Miguel Urina-Triana MD, FACC4 | Mohammed Arafah5 | Jaw-Wen Chen MD, FAHA, FESC6 | Apichard Sukonthasarn7 | Valérie Corp dit Genti8 | Véronique Daclin8 | Eric D. Peterson MD, MPH1

1Duke Clinical Research Institute, Duke University School of Medicine, Durham, North Carolina, USA
2University of Texas Southwestern Medical Center, Dallas, Texas, USA
3Lomonosov Moscow State University Medical Centre, Moscow, Russia
4Faculty of Health Sciences, Simón Bolívar University, Barranquilla, Colombia
5King Saud University, Riyadh, Saudi Arabia
6Division of Cardiology, Taipei Veterans General Hospital, Taipei, Taiwan
7Department of Medicine, Bangkok Hospital, Chiang Mai, Thailand
8Sanofi-Aventis, Paris, France

Abstract

Background: Half the global burden of cardiovascular disease (CVD) is concentrated in the Asia-Pacific (APAC) region.

Hypothesis: Suboptimal control of low-density lipoprotein cholesterol (LDL-C) may play a large role in the burden of CVD in APAC and non-Western countries.

Methods: The Acute Coronary Syndrome Management (ACOSYM) registry is a multinational, multicenter, prospective observational registry designed to evaluate LDL-C control in patients within 6 months after hospitalization following an acute coronary syndrome (ACS) event across nine countries.

Results: Overall, 1581 patients were enrolled, of whom 1567 patients met the eligibility criteria; 80.3% of the eligible patients were men, 46.1% had ST-elevation myocardial infarction, and 39.5% had non-ST-elevation myocardial infarction. Most (1245; 79.5%) patients were discharged on a high-intensity statin. During the follow-up, only 992 (63.3%) patients had at least one LDL-C measurement; of these, 52.9% had persistently elevated LDL-C (>70 mg/dl). The patients not discharged on a high-dose statin were more likely (OR 3.2; 95% CI 2.1–4.8) to have an LDL-C above the 70 mg/dl LDL-C target compared with those who were discharged on a high-dose statin.

Conclusion: Our real-world registry found that a third or more of post-ACS patients did not have a repeat LDL-C follow-up measurement. In those with an LDL-C follow-up measurement, more than half (52.9%) were not achieving a ≤70 mg/dl LDL-C goal, despite a greater uptake of high-intensity statin therapy than has been observed in recent evidence. This demonstrates the opportunity to improve post-ACS lipid management in global community practice.

Keywords

acute coronary syndrome, lipid management, low-density lipoprotein cholesterol, non-Western countries, statin therapy
1 | INTRODUCTION

Cardiovascular disease (CVD) remains a major cause of death globally, resulting in 17.8 million deaths worldwide in 2017. It is estimated that approximately half of the global burden of CVD is concentrated in the Asia-Pacific (APAC) region. In developing countries, age-specific cardiovascular mortality rates have not decreased to the same extent as mortality rates in high-income countries.

Lipid-lowering therapies (LLT), including statins, are a cornerstone of secondary prevention. The 2018 American guidelines recommend up titration of LLT if low-density lipoprotein cholesterol (LDL-C) remains over 70 mg/dl, while the 2019 European guidelines use an LDL-C goal of <55 mg/dl as a class IA recommendation in secondary prevention, and an LDL-C of <40 mg/dl as a class IIb/B goal. In patients not reaching their target LDL-C concentration on maximally tolerated statin therapy, both guidelines recommend adding ezetimibe and, in some subgroups, proprotein convertase subtilisin/kexin type 9 inhibitors.

Recent data have suggested that LDL-C target attainment in certain countries in Asia, Eastern Europe, and the Middle East is suboptimal, with limited information on the treatment success and characteristics of high-risk CVD patients. The guidelines for target LDL-C in these countries vary but generally align with either the US or European guidelines.

The objective of this registry was to describe LDL-C levels following acute coronary syndrome (ACS) in patients from nine countries: Colombia, Hong Kong, Indonesia, Malaysia, Russia, Saudi Arabia, Singapore, Taiwan, and Thailand, and to understand factors associated with LDL-C control post-ACS.

2 | METHODS

2.1 | Registry design

The Acute Coronary Syndrome Management (ACOSYM) registry is a multinational, multicenter, prospective observational registry designed to evaluate LDL-C goal achievement and use of LLT in patients with recent ACS in nine countries: Colombia, Hong Kong, Indonesia, Malaysia, Russia, Saudi Arabia, Singapore, Taiwan, and Thailand. Patient inclusion criteria were recent (≥12 weeks) hospitalization for ACS (unstable angina or myocardial infarction) and ≥18 years of age. ACS was defined as any group with clinical symptoms compatible with ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), or hospitalization with discharge diagnosis of unstable angina. Patients were enrolled either during hospitalization due to ACS or at routine clinical follow-up within 12 weeks post-hospitalization. Patients were excluded from the registry if they were unable or unwilling to provide informed consent (including cognitive or language barriers to comprehension), an anticipated life expectancy <6 months, participation in any clinical trial at the time of enrollment, or pregnancy.

After the baseline visit, registry-specific follow-up visits were scheduled at 3 and 6 months (Table S1) and could be conducted via phone or in person by the study coordinator, clinic nurse, or site investigator. In Saudi Arabia and Russia, all visits were conducted by physicians as per local laws. Patients who did not have a routinely scheduled in-person visit could be followed up via telephone visit by the investigator. Patient data collected at baseline included demographics, ACS details (including treatment prior to hospitalization due to ACS and after ACS), medical history, physical examination, laboratory measurements, and treatment patterns. Patient data recorded at subsequent visits (at 3 months, 6 months, or during an unscheduled visit) included a physical examination, and documentation of any laboratory measurements and medication changes since the prior study visit. As this was an observational registry, no study-specific labs were mandated and only those collected as part of routine clinical care were captured.

The registry began on December 12, 2017 and was completed on October 10, 2019. All patients were followed for 6 months. Enrollment was completed on March 31, 2019.

Two analysis periods were defined in this registry: the baseline period was defined as up to 14 days from the ACS admission, including the day of ACS admission, and the follow-up period as the period starting on the 15th day after ACS admission (Figure 1). Patients within the primary objective population had at least one LDL-C value measured during the follow-up period. The first LDL-C measurement on the day of admission or within 14 days of admission was considered as the “baseline” value. All LDL-C levels measured over the follow-up period were collected and considered as follow-up value, but the last one available was used for target achievement assessment. The primary objective of the registry was to describe the proportion of post-ACS patients reaching the four LDL-C targets within 6 months: <130, <100, <70, and <50 mg/dl. For descriptive purposes, the following cutoffs were used to describe categories of LDL-C achievement: ≥160 mg/dl, ≥130 to <160 mg/dl, ≥100 to <130 mg/dl, ≥70 to <100 mg/dl, ≥50 to <70 mg/dl, and <50 mg/dl.

Data on statin use was collected prior to ACS admission and at the time of discharge. High-intensity statin therapy was defined as the daily dose expected to lower LDL-C by >50% (atorvastatin ≥40 mg, rosuvastatin ≥20 mg). Moderate-intensity statin therapy was defined as the daily dose expected to lower LDL-C by ~30% to <50% (atorvastatin 10 to <40 mg, rosuvastatin 5 to <20 mg, simvastatin ≥20 mg, pravastatin ≥40 mg, lovastatin 40 mg, fluvastatin XL 80 mg, fluvastatin 40 mg twice daily [bid], pitavastatin ≥2 mg), and all other statin doses were considered low-intensity.

2.2 | Statistical analysis

The number and percentages of patients who reached specific LDL-C ranges and a two-sided 95% confidence interval (CI) were calculated. When sample sizes were small, the Clopper-Pearson algorithm was used for computation of the 95% CI and is based on exact binomial distribution.
Categorical variables were summarized as the number and percentage of patients in each category. Continuous variables were described using mean and SD. The count of missing observations was provided.

A logistic regression model15 was used to describe the association between non-achievement of LDL-C <70 mg/dl and potential associated factors including demographic characteristics, lipid profile, medical history, treatments at discharge, and disease characteristics.

At first, univariate models were run on all potential associated factors (Table S2). Then, a multivariable model, based on all factors statistically significant at univariate step with \( p < 0.20 \), was implemented using a stepwise selection procedure with an entry threshold of \( p < 0.20 \) and a stay threshold of \( p < 0.10 \). Odds ratio (OR), 95% CI and corresponding \( p \) values were provided for univariate models and for each of the factors retained in the final step of the stepwise selection procedure.

2.3 | Overview of ethical standards

This registry was conducted in compliance with the protocol and in accordance with the ethical principles that have their origin in the Declaration of Helsinki. Each participating site acted in accordance with local regulations, including those on data protection, and obtained Institutional Review Board approval. Patients were only included in the registry if they had a completed case report form and had provided written informed consent.

3 | RESULTS

A total of 1581 patients were enrolled, of whom 14 were excluded; 13 did not meet the ≤12 weeks post-ACS time interval, and one patient had an unknown baseline event type.

The remaining 1567 patients formed the eligible population. Of these, 1492 (95.2%) patients completed the registry; 31 patients died, 11 patients chose to discontinue, 31 patients were lost to follow-up, one patient had a stroke and did not attend follow-up, and information regarding discontinuation is missing for one patient (Figure S1).

Eligibility by country was as follows: Russia \((n = 299)\), Colombia \((n = 264)\), Saudi Arabia \((n = 201)\), Taiwan \((n = 200)\), Thailand \((n = 200)\), Malaysia \((n = 150)\), Singapore \((n = 96)\), Indonesia \((n = 89)\), and Hong Kong \((n = 68)\). Overall, 80.3% \((n = 1258)\) of patients were male. The mean (SD) age at baseline was 59.9 (11.6) (Table 1).

From the eligible population, 992 (63.3%) patients had at least one LDL-C value measured more than 14 days following ACS admission (primary objective population) (Figure S2). The characteristics of those with an LDL-C measurement >14 days post-ACS were in general similar to the overall eligible population (Table 1). However, those with LDL-C values included more patients with diabetes, a larger proportion of patients from the APAC region, higher rates of aspirin use, and statin users at discharge.

Of those with LDL-C values available at follow-up \((n = 992)\), 47.1% \((95\% \text{ CI } 43.9–50.2)\) of patients achieved an LDL-C <70 mg/dl5 (Figures 2, S3 and Table S3). The mean (SD) LDL-C value at the target achievement assessment was 77.0 (32.03) mg/dl.

Following multivariable analysis, the likelihood of non-achievement of target LDL-C <70 mg/dl increased as the baseline LDL-C level increased (Table 2).

In addition to this, there was a higher likelihood of not achieving LDL-C targets in patients with no statin use or low/moderate statin potency at discharge compared with high-intensity statin at discharge (<70 mg/dl target: OR 3.2; 95% CI 2.1–4.8) (Table 2, Figure 3).

In the primary objective population \((n = 992)\), 32.1% were on a statin prior to their ACS admission, of whom 39.3% were on a high-intensity statin. At discharge, nearly all patients (96.4%) were on a statin, with information on statin intensity available for 970 patients in the primary objective population. Of these, 80.0% \((n = 776)\) were on a high-intensity statin.

Within this population, 99.1% of patients that achieved an LDL-C of <70 mg/dl were on statins at hospital discharge, while 98.9% of patients that achieved the lower LDL-C goal of <50 mg/dl were on statins at hospital discharge. Within the primary objective population, 80.0% \((n = 776)\) were on high-intensity statins (Table 1, Figure S4).
**TABLE 1**  Key baseline characteristics in those patients with an LDL-C value measured more than 14 days following ACS admission (n = 992) and those without this measurement (n = 575)

| Characteristic | Overall eligible patient population (N = 1567) | With LDL-C value measured >14 days post-ACS (n = 992) | Without LDL-C value measured >14 days post-ACS (n = 575) | p values* |
|----------------|-----------------------------------------------|--------------------------------------------------|--------------------------------------------------|----------|
| Gender (n [%])  |                                               |                                                  |                                                  | 0.459    |
| Male            | 1258 (80.3)                                   | 802 (80.8)                                       | 456 (79.3)                                       |          |
| Female          | 309 (19.7)                                    | 190 (19.2)                                       | 119 (20.7)                                       |          |
| Mean (SD) age   | 59.9 (11.6)                                   | 59.8 (11.4)                                      | 60.1 (11.9)                                      | 0.579    |
| Mean (SD) weight in kg | n = 535                                 | n = 312                                          | n = 223                                          | 0.954    |
|                 | 77.4 (15.5)                                   | 77.4 (15.2)                                      | 77.4 (16.0)                                      |          |
| Mean (SD) BMI value (kg/m²) | n = 525                             | n = 306                                          | n = 219                                          | 0.615    |
|                 | 27.6 (4.9)                                    | 27.7 (5.0)                                       | 27.5 (4.8)                                       |          |
| Medical conditions with >100 patients (n [%]) |                                    |                                                  |                                                  |          |
| Hypertension    | 1022 (65.2)                                   | 633 (63.8)                                       | 389 (67.7)                                       | 0.124    |
| Coronary artery disease | 746 (47.6)                              | 465 (46.9)                                       | 281 (48.9)                                       | 0.446    |
| Diabetes mellitus | 517 (33.0)                               | 348 (35.1)                                       | 169 (29.4)                                       | 0.021    |
| Family history of stroke or MI | 326 (20.8)                             | 213 (21.5)                                       | 113 (19.7)                                       | 0.392    |
| Heart failure   | 297 (19.0)                                    | 164 (16.5)                                       | 133 (23.1)                                       | 0.001    |
| Chronic kidney disease | 132 (8.4)                               | 87 (8.8)                                         | 45 (7.8)                                         | 0.517    |
| Region          |                                               |                                                  |                                                  | <0.001   |
| APACb           | 803 (51.2)                                    | 598 (60.3)                                       | 205 (35.7)                                       |          |
| Colombia        | 264 (16.8)                                    | 129 (13.0)                                       | 135 (23.5)                                       |          |
| Russia          | 299 (19.1)                                    | 139 (14.0)                                       | 160 (27.8)                                       |          |
| Saudi Arabia    | 201 (12.8)                                    | 126 (12.7)                                       | 75 (13.0)                                        |          |
| Mean time in weeks since ACS admission (SD) |         |                                                  |                                                  | <0.001   |
| STEMI (n [%])   |                                               |                                                  |                                                  | 0.166    |
| Emergent thrombolysis received (%) | 723 (46.1)                              | 471 (47.5)                                       | 252 (43.8)                                       |          |
| Emergent PCI received (%) | 246 (34.0)                              | 165 (35.0)                                       | 81 (32.1)                                        | 0.435    |
| Emergent thrombolysis and emergent PCI (%) | 506 (70.0)                              | 324 (68.8)                                       | 182 (72.2)                                       | 0.337    |
| Neither thrombolysis nor PCI (%) | 124 (17.2)                              | 85 (18.0)                                        | 39 (15.5)                                        | 0.382    |
| NSTEMI (n [%])  |                                               |                                                  |                                                  | 0.164    |
| Urgent PCI received (%) | 119 (19.2)                              | 63 (16.6)                                        | 56 (23.3)                                        | 0.126    |
| Unstable angina (n [%]) | 304 (19.4)                              | 176 (17.7)                                       | 128 (22.3)                                       | 0.029    |
| Underwent PCI during hospitalization N = 1566 (n [%]) | 1157 (73.8)                              | 736 (74.2)                                       | 421 (73.2)                                       | 0.182    |
| Underwent CAGB during hospitalization (n [%]) | 65 (4.1)                                | 38 (3.8)                                         | 27 (4.7)                                         | 0.738    |
| Mean number of days of hospitalization (n [%]) | n = 752                               | n = 423                                          | n = 329                                          | 0.069    |
|                 | 8.7 (9.32)                                    | 8.1 (7.4)                                        | 9.4 (11.3)                                       |          |
| Statin use at discharge (any)c | 1511 (96.4)                              | 970 (97.8)                                       | 541 (94.1)                                       | 0.0004   |
| Potency of statin at discharge |                                                  |                                                  |                                                  | 0.0008   |
| High-intensity statin | 1245 (79.5)                              | 776 (80.0)                                       | 469 (86.9)                                       |          |
| Low/moderate-intensity statin | 265 (17.5)                              | 194 (20.0)                                       | 71 (13.1)                                        |          |
| Other medication at baseline |                                                 |                                                  |                                                  |          |
| Aspirin         | 1508 (96.2)                                   | 966 (97.4)                                       | 542 (94.3)                                       | 0.003    |
| Antiplatelet medicines | 1450 (92.5)                             | 929 (93.6)                                       | 521 (90.6)                                       | 0.043    |
| Vitamin K antagonist | 41 (2.6)                                | 25 (2.5)                                         | 16 (2.8)                                         | 0.122    |
| Beta blocker    | 1240 (79.1)                                   | 787 (79.3)                                       | 453 (78.8)                                       | 0.330    |
| ACE inhibitor/angiotensin receptor blocker | 1129 (72.0)                             | 705 (71.1)                                       | 424 (73.7)                                       | 0.288    |
| Other BP-lowering medication | 419 (26.7)                              | 264 (26.6)                                       | 155 (27.0)                                       | 0.324    |
| Other cholesterol-lowering medication | 93 (5.9)                                 | 68 (6.9)                                         | 25 (4.3)                                         | 0.004    |
Among 776 patients on high-intensity statins, 81.8% (95% CI 78.9–84.5) achieved LDL-C <100 mg/dl and 51.2% (95% CI 47.6–54.7) achieved LDL-C <70 mg/dl, whereas among 194 patients on low/moderate-intensity statins 74.2% (95% CI 67.5–80.2) and 33.0% (95% CI 26.4–40.1) achieved <100 and <70 mg/dl, respectively (Figure 3).

Of those with a follow-up LDL-C (n = 992), 73.9% (n = 733) also had a baseline LDL-C measured within 14 days of ACS admission (Table S4). Of those with a baseline and follow-up LDL-C, 72.7% of participants (n = 533) reduced their LDL-C level over time into a lower LDL-C category, while 17.7% of patients (n = 130) remained in the same category and 9.6% of participants (n = 70) had an increased LDL-C value at target achievement assessment (Table S4).

### TABLE 1 (Continued)

| Characteristic | Overall eligible patient population (N = 1567) | With LDL-C value measured >14 days post-ACS (n = 992) | Without LDL-C value measured >14 days post-ACS (n = 575) | p values* |
|---------------|---------------------------------------------|---------------------------------------------------|---------------------------------------------------|-----------|
| Baseline LDL-C available (n [%]) | 1121 (71.5) | 733 (73.9) | 388 (67.5) | 0.007 |
| Mean (SD) baseline LDL-C in mg/dl | 120.7 (45.3) | 121.0 (45.8) | 120.1 (44.4) | 0.759 |
| Median (Q1; Q3) baseline LDL-C in mg/dl | 119.9 (88.2; 147.3) | 119.9 (88.2; 147.7) | 118.9 (88.8; 146.8) | 0.987 |

**FIGURE 2** Primary endpoint: LDL-C target achievement assessment in primary objective population (n = 992). LDL-C, low-density lipoprotein cholesterol

The low rate of LDL-C goal achievement is in line with previous data in non-Western European patients, suggesting that very-high-risk patients do not attain target goals to the same extent as moderate/low-risk patients based on guideline recommendations. A previous multinational study conducted across 18 countries in Africa, Asia, Eastern Europe, Latin America, and the Middle East found that only 32.1% of very-high-risk patients achieved their LDL-C targets compared to 55.7% of moderate-risk patients. Together, these findings suggest that there remains the opportunity to decrease the rates of recurrent ACS events among patients across the globe through improvements in lipid-lowering management.
the low rates of follow-up testing. Follow-up LDL-C testing is critical to ensure patients are continuing to adhere to therapy and to assess treatment response. Efforts to improve lipid management in the regions studied should include ensuring appropriate lipid testing at follow-up. During this registry, it was difficult to determine from the data whether an increase or decrease in LDL-C over time was due to treatment profiles, patient adherence, or a combination of both. A large proportion of post-ACS patients from APAC and non-Western countries do not have LDL-C levels measured as they often do not receive a follow-up test post-ACS. In this registry, only 46.8% of patients who had at least one LDL-C value measured <2 weeks from ACS admission had an additional LDL-C value measured >2 weeks following ACS admission. In addition, the large proportion of patients on high-intensity statins, contrary to results found in other studies, raises the concern for possible selection bias, where either patients who enrolled were more likely to be on high-intensity statins or providers who recruited patients were more aggressive in their recruitment approach than their peers. We also note that the “baseline” LDL-C value could have occurred after statin therapy had already been uptitrated or initiated due to the ACS events, which would have led to an underestimation of a patient’s true pre-ACS hospitalization LDL-C value. However, as the study goal was to evaluate achieved LDL-C rather than change in LDL-C over time, the impact of this on our findings is minimal. Next, our registry was designed to evaluate care of patients in follow-up after ACS hospitalization, which may overestimate lipid control as it did not include those who failed to see a physician in follow-up. These biases may have led to an overestimation of LDL-C goal attainment at follow-up; the actual rate of LDL-C control may be even lower than observed. This possible selection or reporting bias may also suggest that the results regarding non-achievement of LDL-C target post-ACS may underestimate the reality of LDL-C levels in this population.

### 4.1 Limitations

Outside of the United States or Western Europe, availability of real-world data regarding LLT among post-ACS patients is limited. There is often a heterogeneity in dose and regimen of statins and other lipid-lowering agents for post-ACS patients. Among the patients in the primary eligible population in this registry, fewer than half achieved the <70 mg/dl LDL-C target, which is the target for patients at high-risk of CVD and recommended by most lipid management guidelines. Patients using no statins or low/moderate-intensity statins had a higher risk of non-achievement of LDL-C target, compared with those high-intensity statin therapy in the ACOSYM registry. Importantly, in multivariable analysis, the only factors associated with achievement of LDL-C goal were a low LDL-C level at baseline and the use of high-intensity statin at discharge. High-intensity statins may lower LDL-C by more than 50% and thus improve cardiovascular outcomes in patients with prior ACS. Improving and maintaining high uptake of high-intensity statins at discharge will be critical to improving lipid control in high-risk ACS patients.

### 5 Conclusion

Outside of the United States or Western Europe, availability of real-world data regarding LLT among post-ACS patients is limited. There is often a heterogeneity in dose and regimen of statins and other lipid-lowering agents for post-ACS patients. Among the patients in the primary eligible population in this registry, fewer than half achieved the <70 mg/dl LDL-C target, which is the target for patients at high-risk of CVD and recommended by most lipid management guidelines. Patients using no statins or low/moderate-intensity statins had a higher risk of non-achievement of LDL-C target, compared with those

### TABLE 2 Multivariable logistic regression model results of factors associated with non-achievement of LDL-C target <70 mg/dl in primary objective population (n = 992)

| Factors                        | Non-achievement of LDL-C < 70 mg/dl | OR (CI 95%) | p value |
|--------------------------------|-------------------------------------|-------------|---------|
| **Demographic characteristics** |                                     |             |         |
| Region                         |                                     |             |         |
| APAC                           |                                     | 0.119       |         |
| Colombia                       |                                     | 0.75 (0.41–1.37) | 0.343   |
| Russia                         |                                     | 1.37 (0.85–2.20) | 0.192   |
| Saudi Arabia                   |                                     | 0.70 (0.44–1.12) | 0.134   |
| Age (years)                    |                                     |             |         |
| <65                            |                                     |             |         |
| ≥65                            |                                     | 0.420       |         |
| **Marital status**             |                                     |             |         |
| Married                        |                                     |             |         |
| Other                          |                                     |             |         |
| **Lipid profile**              |                                     |             |         |
| Baseline LDL-C (mg/dl)         |                                     | <0.0001     |         |
| ≥70 to <100                    |                                     | Ref.        |         |
| ≥160                           |                                     | 4.68 (2.68–8.16) | <0.0001 |
| ≥130 to <160                   |                                     | 1.85 (1.17–2.93) | 0.009  |
| ≥100 to <130                   |                                     | 0.95 (0.60–1.49) | 0.813  |
| ≥50 to <70                     |                                     | 0.65 (0.34–1.26) | 0.205  |
| <50                            |                                     | 0.17 (0.05–0.53) | 0.002  |
| **Treatments at discharge**    |                                     |             |         |
| Statin at discharge            |                                     |             |         |
| High-intensity                 |                                     |             |         |
| No statin or low/moderate-intensity | 3.15 (2.06–4.84) |         |         |

Abbreviations: APAC, Asia-Pacific; CI, confidence interval; LDL-C, low-density lipoprotein cholesterol; OR, odds ratio.
on high-intensity statins; however, even in patients receiving high-intensity statins, only around half achieved LDL-C <70 mg/dl. Although the benefit and use of high-intensity statins post-ACS is well supported by evidence from clinical research and international guidelines, the current results show that this therapeutic strategy is not completely adopted and optimized in real-world clinical practice in the studied countries and is still not efficacious enough in many patients to allow them to achieve LDL-C targets.

ACKNOWLEDGMENTS
The authors would like to thank the registry participants, registry staff, and investigators for their participation. Statistical analyses were managed by Gregory Bigot, from IVIDATA Life Sciences, Paris, France, and Morgane Guennec, statistical lead at IQVIA, Paris, France. Coordination of the development of this manuscript was provided by Pierre Evenou, PhD, from Sanofi. Professional medical writing and editorial assistance was provided by Jane Juif, MSc, and Nicole Scullion, MRes, from HealthCare21 Communications Ltd, Macclesfield, Cheshire, United Kingdom, a Lucid Group agency, and was funded by Sanofi. This trial was sponsored by Sanofi. Medical writing support was funded by Sanofi.

CONFLICT OF INTEREST
Ann Marie Navar received consulting fees from Sanofi for contributions to the design of ACOSYM. She has also received funding for research to her institution from Amgen, Janssen, Amarin, Sanofi, Regeneron, and honoraria and consulting fees from Amarin, Amgen, Astra Zeneca, BI, Esperion, Janssen, Lilly, Sanofi, Regeneron, NovoNordisk, Novartis, The Medicines Company, New Amsterdam, Cerner, 89Bio, and Pfizer, outside of this registry. Eric Peterson has received research support from Sanofi, Amgen, Janssen, and AstraZeneca and consulting or advisory board fees from Sanofi, Amgen, Janssen, AstraZeneca, Boehringer Ingelheim, Pfizer, Esperion, and Amarin. Miguel Urina-Triana received directly, or through the Bios Foundation, financial support for conducting clinical trials and/or fees as a steering committee member, researcher, lecturer or advisory board member from Abbott, Astra Zeneca, Bayer, Boehringer Ingelheim, Bristol-Myers Squibb, Frosst Laboratories, Johnson & Johnson, Novartis, Novonordisk, Pfizer, Procaps, and Sanofi-Aventis. Simon T Matskeplishvili, Mohammed Arafah, Jaw-Wen Chen, Apichard Sukonthasarn have no conflicts of interest to disclose. Valérie Corp dit Genti is an employee and stakeholder of Sanofi. Véronique Daclin was an employee of Sanofi during the manuscript development, and she is a stakeholder of Sanofi.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request and with permission from Sanofi.
ORCID
Ann Marie Navar https://orcid.org/0000-0002-6197-9860

REFERENCES
1. Kaptoge S, Pennells L, De Bacquer D, et al. World Health Organization cardiovascular disease risk charts: revised models to estimate risk in 21 global regions. Lancet Glob Health. 2019;7(10):e1332-e1345. https://doi.org/10.1016/S2214-109X(19)30318-3.
2. Lawes CMM, Rodgers A, Bennett DA, et al. Blood pressure and cardiovascular disease in the Asia Pacific region. J Hypertens. 2003;21(4):707-716.
3. Poh KK, Ambegaonkar B, Baxter CA, et al. Low-density lipoprotein cholesterol target attainment in patients with stable or acute coronary heart disease in the Asia-Pacific region: results from the Dyslipidemia International Study II. Eur J Prev Cardiol. 2018;25(18):1950-1963. https://doi.org/10.11622/smedj.2019021.
4. Sillars A, Sattar N. Management of lipid abnormalities in patients with diabetes. Curr Cardiol Rep. 2019;21(11):147.
5. Grundy SM, Stone NJ, Bailey AL, et al. 2018 AHA/ACC/ACCVPR/AAPA/ABC/ACPM/ADA/ASPC/NLA/PCNA guideline on the management of blood cholesterol: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol. 2019;73(24):3168-3209.
6. Singh M, McEvoy JW, Khan SU, et al. Comparison of transatlantic approaches to lipid management: the AHA/ACC/Multisociety guidelines vs the ESC/EAS guidelines. Mayo Clin Proc. 2020;95(5):998-1014. https://doi.org/10.1016/j.mayocp.2020.01.011.
7. Reiner Z, Catapano AL, De Backer G, et al. ESC/EAS guidelines for the management of dyslipidaemias: the task force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS). Eur Heart J. 2011;32(14):1769-1818. https://doi.org/10.1093/eurheartj/ehr158.
8. Sabatine MS, Giugliano RP, Kech AC, et al. Evolocumab and clinical outcomes in patients with cardiovascular disease. N Engl J Med. 2017;376(18):1713-1722.
9. Murphy SA, Pedersen TR, Gaciong ZA, et al. Effect of the PCSK9 inhibitor evolocumab on total cardiovascular events in patients with cardiovascular disease. JAMA Cardiol. 2019;4(7):613-619. https://jamanetwork.com/journals/jamacardiology/fullarticle/2733138.
10. Danchin N, Almahmeed W, Al-Rasadi K, et al. Achievement of low-density lipoprotein cholesterol goals in 18 countries outside Western Europe: the International Cholesterol management Practice Study (ICLPS). Eur J Prev Cardiol. 2018;25(10):1087-1094. https://doi.org/10.1177/2047487318777079.
11. Wang Y, Yan BP, Tomlinson B, Lee VWY. Is lipid goal one-size-fits-all: a review of evidence for recommended low-density lipoprotein treatment targets in Asian patients. Eur J Prev Cardiol. 2019;26(14):1496-1506. https://doi.org/10.1177/2047487319843077.
12. Nakamura M, Ako J, Arai H, et al. Investigation into lipid management in acute coronary syndrome patients from the EXPLORE-J study. J Atheroscler Thromb. 2019;26(6):559-572. https://doi.org/10.5555/jat.45583.
13. Li Y-H, Ueng K-C, Jeng J-S, et al. 2017 Taiwan lipid guidelines for high risk patients. J Formos Med Assoc. 2017;116(4):217-248. https://doi.org/10.1016/j.jfma.2016.11.013.
14. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA guide on the primary prevention of cardiovascular disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019;140(11):e596-e646. https://doi.org/10.1161/CIR.0000000000006678.
15. Hosmer DW, Lemeshow S. Applied Logistic Regression. 2nd ed. Hoboken, NJ: John Wiley & Sons, Inc; 2000. http://doi.org/10.1002/0471722146.

SUPPORTING INFORMATION
Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Navar AM, Matskeplishvili ST, Urina-Triana M, et al. Prospective evaluation of lipid management following acute coronary syndrome in non-Western countries. Clin Cardiol. 2021;44(7):955–962. https://doi.org/10.1002/clc.23623