Standardization of laboratory lipid profile assessment: A call for action with a special focus on the 2016 ESC/EAS dyslipidemia guidelines – Executive summary

A consensus endorsed by the Cardiovascular Risk and Prevention Group of the Portuguese Internal Medicine Society, the Portuguese Atherosclerosis Society, the Portuguese Society of Cardiology, the Portuguese Society of Laboratory Medicine, and the Portuguese Association of Clinical Chemistry

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Abstract Even with improvements in lifestyle interventions, better control of cardiovascular (CV) risk factors, and improvements in CV outcomes, cardiovascular disease (CVD) remains the leading cause of morbidity and mortality in Portugal and Europe. Atherogenic dyslipemias, particularly hypercholesterolemia, have a crucial causal role in the development of atherosclerotic CVD. The clinical approach to a patient with dyslipidemia requires an accurate diagnosis, based on harmonized and standardized lipid and lipoprotein laboratory assessments. Results and reports of these tests, together with assessment of total CV risk and the respective therapeutic targets, will help ensure that clinical guidelines and good clinical practices are followed,

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increasing the reliability of screening for lipid disorders, producing more accurate diagnoses and CV risk stratification, and improving CV prevention. To this end, this consensus aims to provide clinicians with practical guidance for the harmonization and standardization of laboratory lipid tests, focusing on the most recent dyslipidemia management guidelines.

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pean Atherosclerosis Society (EAS) and European Society of Cardiology (ESC) for the management of dyslipidemias and for CVD prevention in clinical practice, and following the three specific standards of good clinical practice (GCP) published by the Portuguese Directorate-General of Health (DGS) on this matter specifically in terms of CVD risk stratification and target lipid values. These GCP standards from the DGS should be sources of guidance and instruments of clinical decision support in the National Health Service to promote the development of excellence in health care and its evaluation in the hospital network, health centers, family health units and continuous care.

We advocate appropriate screening, diagnosis, monitoring and treatment of dyslipidemias, as a crucial part of CVD prevention in clinical practice. For assessment of total CV risk, we support the SCORE risk chart for determination of 10-year risk of a first fatal atherosclerotic CV event (e.g. myocardial infarction, stroke or other occlusive arterial disease, including sudden cardiac death), in apparently healthy people with no recognized CVD. Individuals with a history of a CV event, type 1 or 2 diabetes, very high levels of individual risk factors (e.g. familial hypercholesterolemia or blood pressure ≥180/110 mmHg), or chronic kidney disease, have very high or high total CV risk and no further risk estimation is required.

The SCORE data indicate that total risk for CV events is about three times higher than the risk of fatal CVD in men, and four times higher in women, but somewhat less in the elderly. In older patients the likelihood of a first fatal CV event is naturally higher. In older people (>60 years of age), the SCORE risk threshold should not be applied strictly, because their age-specific risk is normally around these levels, even when other CV risk factor levels are normal.

Young people with high levels of risk factors deserve particular consideration. Lifetime risk is probably the best approach to evaluate the impact of risk factors in this population, but there are still insufficient epidemiological cohort data to support its application. In young people, an estimate of their relative risk – rather than their absolute risk, which is presumably low – or the use of 'CV risk age' may be helpful.

### Recommendations for the screening of dyslipidemia

Screening for dyslipidemia is indicated in all adults (men aged ≥40 years and women aged ≥50 years or postmenopausal), particularly in the presence of other classic CV risk factors; in patients with clinical CVD (secondary prevention) or with clinical conditions associated with increased CV risk (primary prevention), especially in patients with obesity, metabolic syndrome and/or diabetes; and in HIV-infected patients (Table 1, adapted from ESC). It is also recommended to screen offspring of patients with severe dyslipidemia and family members of patients with premature CVD.

The rationale of CVD risk assessment is to convince individuals without treatable risk factors and low CV risk to maintain a healthy lifestyle, to recommend individuals with treatable CV risk factors or unhealthy behaviors to modify their attitudes and to treat and manage modifiable risk factors, and to identify subjects who will likely derive most benefit from pharmacotherapy and concomitant lifestyle interventions.

We recommend that CV risk reduction should be individualized and treatment goals should be identified. Low-density lipoprotein cholesterol (LDL-C) is the primary treatment target, but total cholesterol (TC) can be accepted if other lipid parameters are not available. Non-high-density lipoprotein cholesterol (non-HDL-C) and/or apolipoprotein B (ApoB) can be used as secondary treatment targets. We strongly suggest that lipid treatment goals take total CV risk into consideration. LDL-C treatment targets should be:

- For low- and moderate-risk individuals: <115 mg/dl (<3.0 mmol/l)
- For high-risk patients: <100 mg/dl (<2.6 mmol/l), or a reduction of at least 50% if baseline LDL-C is between 100 and 200 mg/dl (2.6-5.2 mmol/l).
- For very high-risk patients: <70 mg/dl (<1.8 mmol/l) or a decrease of at least 50% if baseline LDL-C is between 70 and 135 mg/dl (1.8-3.5 mmol/l).

The diagnosis of dyslipidemia should always be confirmed by subsequent laboratory assessment of lipid profile, carried out in a minimum of four weeks, prior to the beginning of any pharmacological therapy (in line with the DGS’s standard no. 019/2011).

The frequency of testing depends on the person’s CV risk profile. After 4-12 weeks from the start of drug treatment a second fasting lipid panel should be performed. Subsequently, assessments should be performed every three months until the lipid goals are achieved, and thereafter
every 12 months, as clinically indicated. However, when LDL-C lowering therapy is adapted (e.g. any intensification of lifestyle interventions, titration of statin therapy, or adding of non-statin therapies), we recommend a new lipid panel, again 4-12 weeks after treatment adjustment, followed by resumption of the above regimen.

Recommendations for lipid biomarker assessment

We recommend that a baseline lipid assessment should include estimation of TC, triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), LDL-C (calculated with the Friedewald formula, based on fasting plasma TC, TG, and HDL-C values, or determined directly), and non-HDL-C. Fasting and non-fasting lipid levels have similar prediction strength and should be regarded as complementary. Non-fasting lipid levels can be applied in screening and risk estimation; however, in general, a 12-hour fasting period is still considered optimal when lipoprotein measurements are used in CV risk screening and estimation and for characterizing dyslipidemias before treatment.

We are aware of the significant limitations of the Friedewald formula.\textsuperscript{10,11} Its estimates are not valid when TG >400 mg/dl (>4.5 mmol/l), in patients with type III hyperlipoproteinemia (dyslipidemia with accumulation of cholesterol-rich remnants) or chylomicronemia, or in nonfasting specimens. Recently, novel LDL-C estimation formulas such as (non-HDL-C) \times (TG/adjustable factor mg/dl) have been proposed,\textsuperscript{12} in which an adjustable factor was established as the strata-specific median TG:very low density lipoprotein cholesterol (VLDL-C) ratio. Although this new method appears to provide a better estimate of LDL-C (particularly in patients with LDL-C ≤70 mg/dl in the presence of high TG levels), it needs to be more widely validated, and the formula selected in each laboratory determination should be clearly stated.

If available, and in particular clinical circumstances, ApoB and lipoprotein(a) (Lp(a)) can also be estimated. Non-HDL-C is an umbrella term for all plasma atherogenic lipoproteins (VLDL, VLDL remnants, intermediate-density lipoproteins, LDL, and Lp(a)). It is calculated as TC minus HDL-C, and is associated with ApoB levels. A powerful CV risk predictor, non-HDL-C is simple to compute and does not need fasting conditions.\textsuperscript{13} This is the reason for including non-HDL-C, unlike ApoB, in the standard lipid profile assessment.

Measurement of Lp(a) is not currently recommended, and should only be performed in specific patients\textsuperscript{5,16,17} (Table 2). CV risk is significant when Lp(a) >50 mg/dl. In patients at risk with high Lp(a) levels the treatment of modifiable CV risk factors should be intensified, particularly LDL-C (with intensive lipid-lowering therapy). The effect on CVD events of targeting Lp(a) has not been established and Lp(a) should not be a lipid target in CV prevention.

### Table 2

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<th>Indications for Lp(a) screening</th>
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<td>• Premature CVD</td>
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<td>• Familial hypercholesterolemia</td>
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<td>• Family history of premature CVD and/or elevated Lp(a)</td>
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<td>• Recurrent CVD despite optimal lipid-lowering therapy</td>
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<td>• ≥5% 10-year risk of fatal CVD according to SCORE</td>
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<td>• Hemodialysis and CKD\textsuperscript{a}</td>
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<tr>
<td>• Intermediate (3-5%) 10-year risk of fatal CVD according to SCORE\textsuperscript{a}</td>
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</table>

\textsuperscript{a} Possible indications for Lp(a) determination, but not clearly stated in the current international guidelines. CVD: cardiovascular disease; CKD: chronic kidney disease; Lp(a): lipoprotein(a); SCORE: Systematic Coronary Risk Evaluation.
Standardization of laboratory lipid profile assessment

Recommendations for the reporting of laboratory lipid assessments

The expert panel recommends including the methods used for lipid biomarker quantification, as well as the specific equipment employed to that end and the associated variation coefficients, in all laboratory lipid reports.

We strongly emphasize the importance of lipid test reports including specific information on target LDL-C values, according to the different CV risk levels (<70 mg/dl, <100 mg/dl and <115 mg/dl), in line with the DGS’s standard no. 005/2013. This should be accompanied by a supporting statement, such as "CV risk to be determined by the attending physician" (Figure 1). We also propose that laboratory reports should flag nonstandard lipid values based on desirable concentration cut-points, defined by guidelines and consensus statements.

Final word

Atherosclerotic CVD is preventable. We and our scientific societies wish to promote the best health care for individuals of both sexes and all ages who are at CV risk. We are aware that effective CV prevention is frequently overlooked in our daily practice. CV prevention is in fact an ethical obligation. It is important to recognize CV risk, to stress the importance of laboratory reports, and to identify clinical situations that warrant judicious intervention.

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Conflicts of interest

PMS has received lecture honoraria or consulting fees from Bayer, Jaba Recordati, Merck Sharp and Dohme Portugal, Kowa Pharmaceuticals, Novartis, Daichi Sankyo, Amgen, Sanofi-Regeneron, and Tecnimede. JSD has received lecture honoraria or consulting fees from Novo-Nordisk, Merck Sharp and Dohme Portugal, Sanofi-Regeneron, Novartis Oncology, Boehringer-Ingeheim, and Tecnimede. VG has received honoraria from AstraZeneca, Merck Sharp Dohme Portugal, Bial, Jaba Recordati, and Amgen. The other members have no conflicts of interest to declare.

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