



Doctor, am I allowed to drive? A practical case-based guide on fitness to drive in cardiovascular diseases adapted from the Swiss model

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Abstract

From 2016 onwards, a group of cardiologists initially formed in 2013 took the initiative to regulate and standardize the driving rights of European citizens suffering from diverse cardiovascular conditions on a European level. Subsequently, the Romanian government embraced and incorporated these recommendations into law a year later. This process addressed several important new aspects, including stents, myocarditis, and various cardiomyopathies, with a focus on striking a balance between the individual's right to drive a vehicle and the need to safeguard the lives of others. The Romanian law, however, is vague and states that "candidates or drivers from the indicated groups can be issued or renewed their driving licenses only after the condition in question has been effectively treated and subject to the opinion issued by the specialist cardiology doctor and, depending on a case, by performing a periodic medical check" but does not clearly specify how and for how long and to whom exactly the driver's license should be suspended. Interestingly, Switzerland, despite not being an EU member, developed its own set of recommendations three years later, drawing strong inspiration from the German guidelines, which in turn personalized its indications (being the European country with the most publications in this field). A refinement of the refinement, one could say. The indications are clear, precise, and structured in a point-by-point fashion. The purpose of this review is to explore the Swiss guidelines on fitness to drive in cardiovascular diseases interactively, with discussions on fictitious cases, in the hope that doctors will be able to become more familiar with these rigid and often interpretable indications and implement them in their daily practice.

Keywords

fitness to drive, cardiovascular diseases, car accident, sudden death, driving license

Introduction

Cardiovascular conditions or diseases can lead to a sudden impairment of the cerebral functions that constitutes a danger to road safety. These conditions represent grounds for establishing temporary or permanent restrictions to driving. In current practice, the question "Doctor, am I allowed to drive?" is probably addressed mostly at cardiologists. The risk of stroke, acute myocardial infarction, malignant arrhythmia, syncope, or hypotension while driving are risks that cause road accidents and are difficult to assess. Each country had tried to come up with its own regulations, and in 2016 the European Union aimed to standardize these indications by introducing Directive 2016/1106 of July 7th, 2016 [1] (replacing the 2006 one [2]). This document had to be transposed for the legislations of each of the EU member countries. New cardiac problems were included, such as stents and some specific cardiomyopathies, and the previously applied knowledge was updated. The document left the door open to future changes in practice by considering a wide range of new therapeutic options, such as circulatory assistance.

The countries that have performed the most studies on the risk of major cardiovascular events while driving are Canada and Australia [3]. The Canadian Society of Cardiology applied a risk estimation formula to its guidelines for driving – a formula that has been adopted by the EU expert group report and formed the basis of its new directive [4]. The formula includes the time at the wheel, the type of vehicle, the risk of sudden incapacitation, and the probability that this incapacitation will result in harm.

Germany has its own pocket guidelines and the most publications on this subject [5]. Switzerland, inspired by the German model, adapted and completed Germany's recommendations [6]. United Kingdom, through the authority of the Driver & Vehicle Licensing Agency (DVLA) makes the doctor fully responsible for informing the patient in common cases of cardiovascular diseases (angina, acute coronary syndrome, coronary angioplasty, coronary bypass or valve surgery) if they drive cars or motorcycles; the drivers of buses, coaches, or lorries must report to the DVLA themselves [7]. In Switzerland, irrespective of the doctor's right to report, a doctor is obliged to inform his patient about his fitness to drive. The Swiss have developed another authority, namely, the "level 4 doctor" who is a specialist in traffic medicine and can decide whether a citizen can drive without the minimum medical requirements or can drive under restrictions, only on certain sections and types of road.

It is crucial to distinguish between the primary risk and the secondary risk, which arises when a patient has already experienced

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a significant cardiovascular event. Notably, the focus is on the effectiveness of the treatment. It is not solely the disease itself that carries the greatest weight, but rather the timing of its occurrence and the level of control achieved. For instance, a patient with recent myocardial infarction who presents with NYHA III heart failure and an ejection fraction of 25% may be permitted to resume driving within one week provided their condition is adequately managed. On the other hand, an elective bypass patient or a patient with newly diagnosed symptomatic atrial fibrillation may need to wait four weeks before resuming driving activities.

Romania also has regulations, published in 2017, that were inspired by the European model [8]. They are loosely divided into two large parts, the group in which driving is allowed only after “the condition in question has been effectively treated and subject to the opinion issued by the cardiology specialist” and the group for which driving is not allowed at all. Moreover, this division refers to obtaining or renewing the driving permit. Otherwise, any doctor, not just the family doctor (as was the case until recently), will be able to send a driver for examination in an authorized clinic and, within a maximum of three working days from the communication, the driver is obliged to present himself at the indicated clinic for a specialized medical examination. If the condition is confirmed, the clinic will have to inform the traffic police, and the driver will temporarily lose the right to use the license. In this way, this filter is relativized, and different patients with the same disease can be passed or exempted from these measures.

Many cardiologists do not know what to recommend to their patients whom they diagnose with heart diseases. Moreover, many cardiologists believe that they do not represent the authority that should decide in this regard. After all, the right to drive or not is a legal right and not a medical one. The aim of ethics as well as legislation is to ensure that the rights of the individual do not override the protections for the safety of fellow citizens and at the same time ensure that the rights of society to restrict individual actions are limited. Many heart diseases seem apparently “stable,” and a definitive decision is difficult to make, especially for a patient whose driving is integrated into his job. To avoid inequity and remain neutral on the basis of current evidence, in 2019 the Swiss model approved and established a working group comprising two parts: the Swiss Society of Cardiology and the Traffic Medicine Section of the Swiss Society of Legal Medicine. The aim of this interactive review was to translate the recommendations from this official communication into simplified indications (with tables) with the help of clinical scenarios and evocative cases.

Cardiovascular scenarios

The main causes of traffic accidents are violation of traffic rules, lack of attention, and poor vehicular condition. Illness causes fewer than 0.5% of accidents resulting in injuries and rarely result in injury to someone other than the driver [9]. Evidence suggests that people who develop severe and even fatal coronary attacks while driving may have sufficient warning to slow down or stop before losing consciousness, since fewer than half of these accidents result in

property damage and injury [10]. However, sometimes no warning occurs, or a warning sign is misinterpreted or ignored, and this may result in severe injury or death to the driver and other users of the road. Collapse from ischemic heart disease (nonfatal and fatal) appears to account for around 15% of sudden illness crashes, which in turn account for about 1 in 1,000 reportable crashes. Thus, ischemic heart disease poses a relatively small but increasing risk [11].

Disease-specific guidelines are provided in the text. When more than one disease coexists, the more restrictive recommendation prevails. All cardiovascular diseases in this section carry the risk of progression, and therefore in all cases the issue or renewal of the license may be subject to periodic assessment especially if there is risk of deterioration.

There is a lot of heterogeneity in the group of individuals with a particular heart condition (for example, stage and duration of disease, co-morbidities, risk factor profile, and compliance to treatment). It is required a priori to establish two essential groups participating as members of the driving public:

- Group 1 is formed by drivers of vehicles of categories A, A1, A2, AM, B, B1, and BE. These comprise drivers of, e.g., motorcycles, passenger cars, and other small vehicles with or without a trailer.
- Group 2 is formed by drivers of vehicles of categories C, CE, C1, C1E, D, DE, D1, and D1E. This includes drivers of, e.g., vehicles over 3.5 tonnes or vehicles designed for the carriage of more than nine passengers including the driver.

In the following section, we will transform the information on the tables with indications of the Swiss Society of Cardiology and the Swiss Society of Forensic Medicine into fictitious cases.

1. Syncope

Case: A 74-year-old patient, a pensioner syncope while sitting at lunch.

Prodrome: Cold sweats, nausea; No anamnestic indication of epileptogenic genesis

Clinical examination: No relevant abnormalities

Pre-existing conditions: Arterial hypertension, history of appendectomy.

Investigations: Head CT: normal; Holter ECG: Sinus, no relevant arrhythmias; TTE: EF normal, no evidence of structural cause; EEG: No changes typical of epilepsy.

Diagnosis: Vasovagal syncope.

Question: Can he drive?

Answer: Yes, after 1 month (Table 1).

2. Heart failure (any etiology)

Case 1: 50-year-old patient, lawyer, follow-up consultation in the outpatient clinic. Status after severe viral perimyocarditis 4 months ago: initially NYHA IV, EF 20%.

Currently: good recovery, NYHA I-II, heart failure therapy fully dosed, TTE with EF 30%.

Question: Can he drive?

Answer: Yes (Table 2).

Table 1 - Fitness to drive with syncope [6]

| | Group 1 | Group 2 |
|-----------------------------------|--------------------------|--|
| Vasovagal syncope | | |
| • 1x, not sitting/driving | ✓ | ✓ |
| • >1x OR while sitting/driving | ✓ 1-month waiting period | ✓ >3-month waiting period and case-by-case assessment |
| Triggering and recoverable factor | ✓ | ✓ |
| Unclear syncope without prodrome | ✓ 3-month waiting period | ✓ If diagnosis and treatment; Otherwise, 12-month waiting period |

Table 2 - Fitness to drive with heart failure [6].

| | Group 1 | Group 2 |
|------------------------|-------------------------|--|
| NYHA I and II | ✓ | ✓ If EF >35% and normal stress test |
| NYHA III | ✓ If stable | ✗ |
| NYHA IV | ✗ | ✗ |
| LVAD | Case-by-case assessment | ✗ |
| After heart transplant | ✓ After recovery | ✓ NYHA I/II, EF >35% & normal stress test and 3-month waiting period |

Abbreviations: NYHA = New York Heart Association; LAD = left arterial descending artery; LVAD = left ventricular assist device; EF = ejection fraction.

Case 2: 50-year-old patient, truck driver, follow-up consultation. History of subacute STEMI 3 months ago (LAD stented), EF 25% at presentation.

Currently: on sick leave, good recovery, NYHA I heart failure, therapy fully dosed, TTE with EF 40%.

Question: Can he drive?

Answer: Yes, if normal stress test (Table 2).

3. Fitness to drive with coronary heart disease

Case 1: 56-year-old patient, doctor, still hospitalized. NSTEMI two days ago. Coronary angiography: one stent RCA.

TTE: EF normal, no other abnormalities.

Question: Can he drive?

Answer: Yes (Table 3).

Case 2: 46-year-old patient, bus driver. Follow-up 2 months after coronary bypass operation and completion of cardiac rehabilitation. Good recovery, TTE: EF normal, no other abnormalities. **Stress test:** good performance, clinically and electrically negative.

Question: Can he drive?

Answer: No, 3-month waiting period (Table 3).

4. Fitness to drive in the case of bradycardic arrhythmias

Case: 42-year-old patient, painter, consultation for occasional palpitations.

Normal clinical examination, no previous illnesses.

TTE: normal EF, no relevant abnormalities.

Table 3 - Fitness to drive with coronary heart disease [6].

| | Group 1 | Group 2 |
|--------------------------------|---|---|
| ACS (conservative & PCI) | ✓ 1 week waiting period & not angina CCS IV | ✓ If asymptomatic, EF >35%, normal exercise test • 6-week waiting period |
| Elective PCI | ✓ | ✓ |
| Bypass | ✓ After recovery | ✓ If NYHA I-II, EF >35%, normal exercise test • 3-month waiting period |
| Stable coronary artery disease | ✓ No resting angina | ✓ If asymptomatic, EF >35%, normal stress test annually |

Abbreviations: ACS = acute coronary syndrome; PCI = percutaneous coronary intervention; CCS = Canadian Cardiovascular Society; NYHA = New York Heart Association; EF = ejection fraction.

Table 4 - Fitness to drive in the case of bradycardic arrhythmias [6].

| | Group 1 | Group 2 |
|---|-------------------------|--------------------------|
| AV Block I and Wenkebach II | ✓ | ✓ |
| AV Block Mobitz II | | |
| • Paroxysmal in sleep | ✓ After PM implantation | ✓ After PM implantation |
| • While awake | ✓ After PM implantation | ✓ After PM implantation |
| AV Block III born | ✓ If asymptomatic | ✓ After PM implantation |
| AV Block III acquired | ✓ After PM implantation | ✓ After PM implantation |
| RBBB or isolated hemiblock | ✓ | ✓ |
| LBBB | ✓ | ✓ After echocardiography |
| Bifascicular block with normal PQ interval | ✓ | ✓ |
| Bifascicular blocked with prolonged PQ interval | ✓ If asymptomatic | ✓ If asymptomatic |

Abbreviations: AV = atrioventricular; LBBB = left bundle branch block; RBBB = right bundle branch block.

Holter: Paroxysmal second-degree AV block Mobitz II, also during the day, asymptomatic according to the protocol.

Question: Can he drive?

Answer: No (Table 4).

5. Fitness to drive with supraventricular arrhythmias

Case: 33-year-old female patient, student

Emergency: Presentation with tachycardia, "pulse in the head," dizziness, and presyncope, first event. No previous illnesses, no drug abuse, negative family history, healthy lifestyle.

After Valsalva in the emergency department @ Sinus rhythm restoration.

Diagnostic: Atrioventricular nodal reentry tachycardia (AVNRT) in the initial ECG.

Question: Can she drive?

Answer: No (Table 5).

6. Fitness to drive with ventricular arrhythmias

Case 1: 30-year-old patient, healthcare nurse. Intermittent palpitations, no dizziness or syncope; normal clinical examination, no previous illnesses, no cardiovascular risk factors, no drug abuse.

TTE: Normal EF, no relevant abnormalities.

Holter: Intermittent ventricular bigeminy; PVC load >10%, asymptomatic except for palpitations.

Question: Can he drive?

Answer: Yes (see Table 5).

Case 2: 59-year-old patient, truck driver. Status after STEMI (5 years ago, occlusion of the distal LAD), now palpitations. Normal clinical examination, he stopped smoking.

TTE: normal EF, hypokinesia in the antero-septal area.

Holter: 1x VT 48 s, asymptomatic; PVC load 8%.

Question: Can he drive?

Answer: No (see Table 5).

7. Fitness to drive with devices

Case 1: 45-year-old truck driver. Presentation with prodromal syncope. Intermittent AV block grade III on the intensive care unit. PM implantation and PM control with perfect function

Question: Can he drive?

Answer: No, only after a waiting period of 3 months (see Table 6).

8. Fitness to drive with other cardiovascular diseases

Severe aortic stenoses do not represent a danger for both groups if they are treated. Professional drivers also need at least 3 months of convalescence post-transcatheter aortic valve replacement/surgical aortic valve replacement and an EF over 35%. The same principles apply to the other valvulopathies: if the patient is compensated and asymptomatic, he can drive (Table 7). Driving should be stopped when there is syncope or NYHA IV in any valvulopathy.

Congenital heart surgery has led to a major improvement in survival of patients with CHD. There is a continuously growing number of "GUCH," i.e., grown up congenital heart disease patients, in particular those with more complex disease. Precise data on the size and composition of the GUCH population are lacking. More adults than children are living with congenital heart disease, and this population is estimated to be growing at 5% per year [12]. This young population wants to lead a normal life but a small part of this population (mainly those with complex defect) is threatened by arrhythmia and sudden death. In European, Canadian, and American [13–15] recommendations, there is no focus on fitness to drive. The Swiss recommendations are also relative, the decision being left mainly to the discretion of the doctor and the personalized discussion with the patient (Table 8).

No published dataset addresses the risk of nonfatal loss of consciousness in hypertrophic cardiomyopathy patients. In Group 1, driving may continue, provided there is no history of syncope. If there is a history of syncope, driving must cease until the condition has been satisfactorily controlled and treated. In Group 2, driving must cease when two or more of the following conditions are present: LV

Table 5 - Fitness to drive with supraventricular arrhythmias [6]. Relevant symptoms = severe dizziness, presyncope, syncope. Regular: AVNRT, atrial flutter, atrial tachycardias. Effective therapy: medicinal, interventional, cardiac pacemaker.

| | Group 1 | Group 2 |
|-------------------------------|--|--|
| Regular SV tachycardia | | |
| • Without relevant symptoms | ✓ | ✓ |
| • With relevant symptoms | ✓ After ablation, 4 weeks of waiting and cardiological control | ✓ After ablation, 4 weeks of waiting and cardiological control |
| WPW No history of tachycardia | ✓ | ✓ |
| Atrial fibrillation | | |
| • Without relevant symptoms | ✓ | ✓ |
| • With relevant symptoms | ✓ After therapy, 4 weeks of waiting and cardiological control | ✓ After therapy, 4 weeks of waiting, and cardiological control |

Abbreviations: SV = supraventricular; WPW = Wolf Parkinson White syndrome

Table 6 - Ventricular arrhythmias: normal and structural heart disease [6]. Symptoms: severe vertigo, presyncope, syncope; therapy: drug or ablation or ICD.

| Ventricular arrhythmias: no structural heart disease, no ion channel disease (typically from RVOT or LVOT) | | |
|--|---|---|
| | Group 1 | Group 2 |
| PVC | ✓ | ✓ |
| NSVT and VT | | |
| • without relevant symptoms | ✓ | Case-by-case assessment |
| • with relevant symptoms | ✓ After therapy, 4 weeks of waiting and cardiological control | ✓ After therapy, 4 weeks of waiting and cardiological control |
| Idiopathic ventricular fibrillation | ✓ After ICD | ✗ |
| Ventricular arrhythmias: structural heart disease (CAD, dilated cardiomyopathy) | | |
| PVC | ✓ | ✓ |
| NSVT | | |
| • Without relevant symptoms | ✓ | Case-by-case assessment |
| • With relevant symptoms | ✓ After therapy, 3-month wait and cardiological control | ✗ |
| Sustained VT with/without symptoms | ✓ After ICD | ✗ |

Abbreviations: RVOT: right ventricular outflow tract; LVOT: left ventricular outflow tract; PVC: premature ventricular contraction; NSVT: nonsustained ventricular tachycardia; VT: ventricular tachycardia; ICD: implantable cardioverter-defibrillator; CAD: coronary artery disease;

wall thickness > 3 cm, nonsustained ventricular tachycardia, family history of sudden death (in a first-degree relative), failure of increase of blood pressure with exercise.

In long QT syndrome, no restrictions are formulated if there is no history of previous syncope or torsade du pointes, and QTc is never

Table 6 - Devices: After PM/ICD implantation or replacement [6].

| | Group 1 | Group 2 |
|--|---------------------------|--|
| PM: with history syncope | ✓ 1 week waiting period | ✓ 3-month waiting period and cardiological control <i>Change: 2-week waiting period</i> |
| PM: without history of syncope | ✓ 1 week waiting period | ✓ 4-week waiting period and cardiological control <i>Change: 2-week waiting period</i> |
| ICD | ✓ With restrictions | ✗ |
| CRT-D in non-ischemic cardiomyopathy & for primary prevention | ✓ 1 week waiting period | ✓ If: • >6 months sustained improvement to EF >50% • and D function deactivated |
| After ICD activation | | |
| One-time, adequate shock | ✓ 3 months waiting period | |
| Inappropriate shock | ✓ When cause resolved | |
| Antitachycardic pacing of ventricular tachycardia with relevant symptoms | ✓ 3-month waiting period | |
| without relevant symptoms | ✓ | |

Abbreviations: PM, pacemaker; ICD, implantable cardioverter-defibrillator; CRT-D, resynchronisation therapy-defibrillator

Table 7 - Valvular disease [6].

| | Group 1 | Group 2 |
|----------------------|-----------------------|--|
| Aortic Stenosis | ✓ | ✓ If not severe, annual re-evaluation |
| Asymptomatic | ✗ | ✗ |
| Symptomatic | ✓ After convalescence | ✓ 3 month waiting period, NYHA I-II, EF >35% |
| After treatment | | |
| Other valvulopathies | | |
| Asymptomatic | ✓ | ✓ EF >35% and no severe mitral stenosis |
| Symptomatic | Depending on NYHA | ✓ EF >35% and no severe mitral stenosis and NYHA I-II |
| After treatment | ✓ After convalescence | ✓ EF >35% and NYHA I-II and waiting period of 3 months |

Abbreviations: NYHA, New York Heart Association; EF, ejection fraction

>500 ms. If a history of syncope, torsade du pointes, or QTc >500 ms exists, an ICD is indicated, and Group 1 can still drive whereas Group 2 cannot (Table 9). In the Brugada syndrome, the recommendations should take into account the risk of sudden cardiac incapacitation but generally, Group 1 can continue driving while wearing an ICD whereas Group 2 cannot (Table 9). In subjects with a Brugada ECG, but no symptoms, the annual risk of sudden cardiac incapacitation is <1%. In individuals who have had one syncope, the risk is 3% to 4%.

Table 8 - Congenital and hypertrophic diseases [6].

| | Group 1 | Group 2 |
|-------------------------------|---|-------------------------|
| Congenital diseases | ✓ | ✓ |
| • Asymptomatic | Case-by-case assessment | Case-by-case assessment |
| • Symptomatic | | |
| Hypertrophic cardiomyopathies | ✓ | ✓ If no ICD indicated |
| • Asymptomatic | Depending on NYHA and syncope anamnesis | ✗ |
| • Symptomatic | | |

Table 9 - Ion channel anomalies [6].

| | Group 1 | Group 2 |
|--------------------|-----------|--|
| Congenital long QT | ✓ If ICD* | Case-by-case assessment ✗ If ICD is indicated |
| Brugada syndrome | ✓ If ICD* | Case-by-case assessment ✗ If ICD is indicated |

*If ICD indication according to the patient's wishes (agree/disagree).

Table 10 - Miscellaneous [6].

| | Group 1 | Group 2 |
|--------------------------|--|---|
| Arterial hypertension | ✓ Without cerebral symptoms or visual disturbances | ✓ Without cerebral symptoms or visual disturbances BP <180 mmHg systolic / <110 mmHg diastolic |
| Pulmonary hypertension | ✓ If NYHA I-III | ✓ If NYHA I-II & no permanent O ₂ need |
| Thoracic aortic aneurysm | ✓ If <6.5 cm | ✓ If <5.5cm |

In individuals who have had sudden cardiac death, the risk of sudden cardiac incapacitation is approximately 10% to 20% [16].

Hypertension is not considered a danger for drivers, unless it is malignant (Table 10). Apart from this extreme condition, grade 3 hypertension is strongly and proportionally linked to stroke occurrence with an annual incidence of above 0.3% when systolic blood pressure is >180mmHg [17]. In consequence, professional drivers should not be allowed to drive until their hypertension is under control. Grade 1 or 2 hypertension can be considered as a cardiovascular risk with no immediate consequence for driving safety. It should be treated but should not be a cause of driving restriction.

The indications for aortic aneurysms respect the thresholds of the European guidelines for surgical intervention; group 2 has a limit of 5.5 cm, similar to the limit of the ascending aorta. Of course, patients with Marfan syndrome have a limit of 0.5 cm less [18].

Conclusions

The cardiologist's obligation to inform his/her patient about the right to drive or not is underestimated and underrepresented. This practical guide aims to assist physicians in approaching the legal

aspects of their job in a more accessible manner, recognizing its equal importance alongside the medical component.

Fortunately, the risk of a road accident due to a cardiovascular disease remains low. As a general rule, the restrictions are more severe for professional drivers. Normal drivers can drive with any ejection fraction if they are compensated, soon after a myocardial infarction (regardless of whether they are stented or not), immediately after PM or ICD implantation; the professionals always need a waiting period, an EF of over 35%, and a negative stress test. In the case of PM, professional drivers also have to wait, and unfortunately wearing an ICD completely contraindicates driving in this category. Driving is also permitted with a left ventricular assist device, after a heart transplant, or with Brugada syndrome (if the patient receives an ICD).

Disease-specific guidelines are provided in the text. When more than one disease coexists, the more restrictive recommendation prevails. All cardiovascular diseases in this section carry the risk of progression, and therefore in all cases the issue or renewal of the license may be subject to periodic assessment especially if there is risk of deterioration. It must be acknowledged that the group of individuals with a specific heart condition exhibits a wide heterogeneity, including differences in disease stage and duration, co-existing medical conditions, risk factors, and adherence to treatment. Determining whether to grant or deny the privilege to drive

remains therefore a challenging decision to make in many scenarios. The author, however, holds the hope that this review has provided insights and instilled more confidence in this ever-evolving and often arbitrary field.

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REFERENCES

1. European Parliament. Directive (EU) 2016/1106 of the Commission of 7 July 2016 amending Directive 2006/126/EC of the European Parliament and of the Council on driving licenses. Available at: <http://data.europa.eu/eli/dir/2016/1106/oj>. Accessed 10 July 2023.
2. Directive 2006/126/EC of the European Parliament and of the Council of 20 December 2006 on driving licences. Available at: <http://data.europa.eu/eli/dir/2006/126/oj>. Accessed 10 July 2023.
3. Assessing fitness to drive for commercial and private vehicle drivers: Medical standards for licensing and clinical management guidelines AUSTRROADS National Road Transport Commission (2022 edition). Sydney 2022. Available at: https://austroads.com.au/_data/assets/pdf_file/0037/498691/AP-G56-22_Assessing_Fitness_Drive.pdf. Accessed 10 July 2023.
4. Simpson C, Dorian P, Gupta A, Hamilton R, Hart S, Hoffmaster B, et al.; Canadian Cardiovascular Society Consensus Conference. Assessment of the cardiac patient for fitness to drive: drive subgroup executive summary. *Can J Cardiol* 2004;20(13):1314–20.
5. Deutsche Gesellschaft für Kardiologie – Herz- und Kreislaufforschung e.V. (2023) Pocket-Leitlinien. Fahreignung bei kardiovaskulären Erkrankungen, Version 2023. Börm Bruckmeier Verlag, Grünwald. Available at: https://leitlinien.dgk.org/files/14_2023_pocket_leitlinien_fahreignung.pdf. Accessed 10 July 2023.
6. Buser M, Christen S, Schär B, Fellay M, Pfäffli M. Fahreignung und kardiovaskuläre Erkrankungen: gemeinsame Richtlinien der Schweizerischen Gesellschaft für Kardiologie und der Schweizerischen Gesellschaft für Rechtsmedizin. *Cardiovasc Med* 2019;22:w02023. doi:10.4414/cvm.2019.02023.
7. Driver and Vehicle Licensing Agency. Assessing fitness to drive – a guide for medical professionals, Version August 2018. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736938/assessing-fitness-to-drive-a-guide-for-medical-professionals.pdf. Accessed 10 July 2023.
8. ORDIN Nr. 1530/2017 din 28 decembrie 2017 pentru modificarea Normelor minime privind aptitudinile fizice și mentale necesare pentru conducerea unui autovehicul, aprobate prin Ordinul ministrului sănătății nr. 1.162/2010. Available at: <http://sant.ro/informatii-utile/legislatie/legislatie-in-vigoare/2017/Ordin%20nr%201530%20din%2028%20decembrie%202017.pdf>. Accessed 11 July 2023.
9. Hughes BP, Newstead S, Anund A, Shu CC, Falkmer T. A review of models relevant to road safety. *Accid Anal Prev* 2015;74:250–70. doi: 10.1016/j.aap.2014.06.003.
10. Chee JN, Simpson C, Sheldon RS, Dorian P, Dow J, Guzman J, Raj SR, Sandhu RK, Thiruganasambandamoorthy V, Green MS, Krahn AD, Plonka S, Rapoport MJ. A systematic review of the risk of motor vehicle collision in patients with syncope. *Can J Cardiol* 2021;37(1):151–161. doi: 10.1016/j.cjca.2020.02.070.
11. Miao Q, Zhang YL, Miao QF, Yang XA, Zhang F, Yu YG, Li DR. Sudden death from ischemic heart disease while driving: cardiac pathology, clinical characteristics, and countermeasures. *Med Sci Monit* 2021;27:e929212. doi: 10.12659/MSM.929212.
12. Marelli AJ, Mackie AS, Ionescu-Ittu R, Rahme E, Pilote L. Congenital heart disease in the general population: changing prevalence and age distribution. *Circulation* 2007;115(2):163–72. doi: 10.1161/CIRCULATIONAHA.106.627224.
13. Baumgartner H, De Backer J, Babu-Narayan SV, Budts W, Chessa M, Diller GP, et al.; ESC Scientific Document Group. 2020 ESC Guidelines for the management of adult congenital heart disease. *Eur Heart J* 2021;42(6):563–645. doi: 10.1093/eurheartj/ehaa554.
14. Silversides CK, Marelli A, Beauchesne L, Dore A, Kiess M, Salehian O, et al. Canadian Cardiovascular Society 2009 Consensus Conference on the management of adults with congenital heart disease: executive summary. *Can J Cardiol* 2010;26(3):143–50. doi: 10.1016/s0828-282x(10)70352-4.
15. Warnes CA, Williams RG, Bashore TM, Child JS, Connolly HM, Dearani JA, et al. ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Develop Guidelines on the Management of Adults With Congenital Heart Disease). Developed in Collaboration With the American Society of Echocardiography, Heart Rhythm Society, International Society for Adult Congenital Heart Disease, Society for Cardiovascular Angiography

and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2008;52(23):e143–e263. doi: 10.1016/j.jacc.2008.10.001.

16. Gehi AK, Duong TD, Metz LD, Gomes JA, Mehta D. Risk stratification of individuals with the Brugada electrocardiogram: a meta-analysis. *J Cardiovasc Electrophysiol* 2006;17(6):577–83. doi: 10.1111/j.1540-8167.2006.00455.x.

17. Kannel WB, Dawber TR, Sorlie P, Wolf PA. Components of blood pressure and risk of atherothrombotic brain infarction: the Framingham study. *Stroke* 1976;7(4):327–31. doi: 10.1161/01.str.7.4.327.

18. Erbel R, Aboyans V, Boileau C, Bossone E, Bartolomeo RD, Eggebrecht H, et al.; ESC Committee for Practice Guidelines. 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases: Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult. The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC). *Eur Heart J*. 2014;35(41):2873–926. doi: 10.1093/eurheartj/ehu281.