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HOW TO SCREEN FOR AT RISK ALCOHOL USE IN TRANSPLANT PATIENTS? FROM INSTRUMENT SELECTION TO IMPLEMENTATION OF THE AUDIT-C

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Running title: *alcohol screening instrument for routine care*

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Accepted Article

HOW TO SCREEN FOR AT RISK ALCOHOL USE IN TRANSPLANT PATIENTS? FROM INSTRUMENT SELECTION TO IMPLEMENTATION

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ABSTRACT

Background: Given that drinking > 2- 3 units of alcohol daily might already have adverse health effects, regular screening of at risk drinking is warranted. We aimed to select and pilot a short instrument to accurately screen for at risk drinking in transplant patients.

Methodology and results: Five consecutive steps were completed: A comprehensive literature review identified 24 possible self-report instruments (step 1). These instruments were scored on six yes/no criteria (i.e. length, concept measured, diagnostic accuracy, population, manual available, cost) (step 2). Four nurses piloted three instruments with the highest score, and were interviewed on their experiences with using the AUDIT-C, TWEAK and Five-Shot. The AUDIT-C was the easiest to use and score, and items were clear. Cognitive debriefings with 16 patients were conducted to verify clarity of instructions and items, and suggestions were incorporated into a modified version of the AUDIT-C (step 4). A convenience sample of 130 Dutch-speaking heart transplant patients completed the modified AUDIT-C during a scheduled visit (Step 5), revealing that 27.6% of patients showed at risk drinking.

Conclusion: The AUDIT-C might be a suitable instrument to identify at risk drinking in routine post-transplant follow-up. Further validation, however, is indicated.

Key words: *At risk drinking, alcohol use, screening, solid organ transplantation.*

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BACKGROUND

Drinking alcohol is a common and socially accepted behavior in many parts of the world, and the amount of alcohol consumption per capita continues to further increase over time ¹. This is surprising, given alcohol's intoxicating and dependence-producing characteristics. More specifically, the World Health Organization estimated that 5.3% of all deaths in 2016 were due to alcohol use, making it the third leading cause of death globally ¹. Currently, more than 200 diseases are known to be related to alcohol use, including cardiovascular disease, liver cirrhosis, some forms of cancer, mental disorders, obesity as well as injuries ¹.

However, it is important to make a distinction between substance use disorder, hazardous drinking and drinking alcohol in amounts that does not cause health problems or diseases. The Diagnostic and Statistical Manual 5th edition (DSM-V) defines 'substance use disorder' as a wide variety of problems arising from substance use, of which a minimum of two of 11 criteria need to be present, with criteria for instance referring to hazardous use, tolerance and social/interpersonal problems related to use, among other characteristics ². In contrast to previous editions of the DSM, a distinction between alcohol dependence or abuse is no longer being made. Hazardous drinking, also called at risk drinking, is defined as *"a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others. Hazardous drinking patterns are of public health significance despite the absence of any current disorder in the individual user"* ².

Unfortunately, however, there is no universal agreement on how much alcohol one can drink without endangering one's health, and the guidelines on responsible drinking vary widely between countries ³. Some countries use daily or weekly limits for men and woman, while other countries don't differentiate by gender. In Australia, for instance, men and women are told they should drink no more than 20 grams each day. American women are allowed 42 grams per day, but no more than 98 grams per week. In contrast, men in the United States are told they can safely drink 56 grams per day and up to 196 grams per week. In the UK, men and women are advised to drink no more than 14 units a week, and to spread them over the week rather than binge drinking. In stark contrast, the upper weekly limit for men in Poland is substantially higher with 280 grams per week. Moreover, despite the World Health Organization defining a standard drink as one containing 10 grams of alcohol, most countries use their own definition. A standard drink in Austria for instance contains 20 grams of alcohol, in the United States 14 grams and in Iceland and the United Kingdom 8 grams ³.

Different screening measures were considered to detect hazardous drinking/at risk drinking, including the use of biomarkers ⁴. However, in the light of busy outpatient clinic visits, where other medical and psychosocial assessments need to be completed, the transplant teams within our hospitals were in need of a validated, inexpensive, user friendly and short screening instrument that can easily be implemented in routine clinical practice.

The purpose of the present study therefore was to identify a self-report instrument that is most suitable to screen for at risk drinking in adult transplant patients, to implement it, and to determine the prevalence of at risk drinking in a cross-sectional study in heart transplant patients.

METHODS AND RESULTS

In line with the conceptual framework outlined by the Food and Drug Administration ⁵, a stepwise approach was used to select the most suitable self-report instrument to screen for alcohol use in adult transplant patients, consisting of a) a comprehensive literature search, b) selection of potentially relevant instruments, c) piloting of selected instruments by nurses and d) cognitive debriefings in transplant patients. Ethical approval for these steps was obtained on February 16, 2016. The selected instrument was subsequently used in a cross-sectional study to determine the prevalence of at risk drinking in heart transplant patients. We defined at risk drinking as drinking more than 3 alcohol units daily for men, and more than 2 units for women (i.e. more than 21 or 14 units weekly), based on the guidelines set forward by the Federal Public Service of Belgium ⁶. This study was approved by the ethical committee of the University Hospitals of Leuven on March 15, 2016. The next paragraphs describe the methodology and results for each step.

STEP 1: LITERATURE SEARCH

METHODS

Design

This step aimed to generate a comprehensive overview of self-report instruments currently being used to screen for at risk drinking in chronic patient populations, following the Cochrane guidelines on conducting a systematic review ⁷. The reporting was done in concordance with the principles of the PRISMA-guidelines ⁸.

Search approach, databases, search string, and inclusion and exclusion criteria

The databases PubMed and the Cochrane Library were searched from inception until December 9, 2015, using a search string consisting of a combination of controlled Thesaurus terms and free text words referring to alcohol use and self-report instruments, respectively. Title and abstract screening was done by two researchers independently, followed by a full text analysis of potentially relevant publications, using the following inclusion criteria: the paper a) had to be written in English or Dutch, b) described the development and validation of a self-report screening instrument for alcohol use in adults or used a self-report instrument investigating at risk drinking/alcohol abuse in adults in a quantitative study. Studies on pregnant women or people with psychiatric conditions were excluded, as well as comments or editorials. In addition, reviews on alcohol use were scrutinized for potentially additionally relevant self-report screening instruments.

Data extraction

The following data were extracted and tabulated by the same two researchers: instrument developer, purpose (i.e. at risk drinking, alcohol abuse, and excessive alcohol use), setting and population, number of questions, scoring, and information on reliability and validity (e.g. sensitivity, specificity, internal consistency).

RESULTS

In total, 24 unique screening instruments⁹⁻³⁰ were found, of which their characteristics are summarized in table 1.

INSERT TABLE 1 ABOUT HERE

STEP 2: SELECTION OF POTENTIALLY SUITABLE INSTRUMENTS TO SCREEN FOR AT RISK

DRINKING

METHODS

The 24 instruments identified based on our literature review were subsequently evaluated against the following pre-specified criteria:

- 1) Is the screening instrument focusing on at risk drinking? (yes: 1, no: 0)
- 2) Is the screening instrument sufficiently short (i.e. 5 items or less) in order to be useful in daily clinical practice? (yes: 1, no: 0)
- 3) Is there a manual available? (yes: 1, no: 0)
- 4) Does the sensitivity and specificity against a diagnostic interview as the gold standard has a higher average score than ≥ 0.70 ? (yes: 1, no: 0) (If not available, positive and negative predictive values were used with the same cut-off.)
- 5) Has the instrument been tested in a (non-psychiatric) hospital setting? (yes: 1, no: 0)
- 6) Can the instrument be used free of charge? (yes: 1, no: 0)

Scores per instrument are summed, yielding a score between 0 and 6 for each instrument, with higher scores indicating higher suitability for clinical practice.

Next, screening instruments with a score of 5 or 6 on these six criteria were discussed during a focus group with eight professionals with various backgrounds (i.e. nurses, psychologists, physicians), in order to select those self-report instruments with the highest face validity for use in clinical practice.

RESULTS

The scores per instrument are summarized in **table 1**. Only three instruments received a score of 6/6, i.e. the AUDIT-C ¹⁰⁻¹², TWEAK ³⁰ and Five-Shot ²⁵. Four instruments received a score of 5, i.e. the AUDIT ¹⁰⁻¹², CAGE ²⁹, FAST ²⁴⁻²⁵, T-ACE ²⁹. The AUDIT-C was preferred over the AUDIT ¹⁰⁻¹², as this is a shorter instrument with excellent sensitivity and specificity when tested against diagnostic interviews. The CAGE ²⁹ focuses more on abuse or dependence, while we are more interested in instruments screening for at risk drinking. The Five Shot ²⁵ combines questions from the AUDIT and CAGE, while being sufficiently short, making the Five Shot a better option to consider. The FAST ²⁴⁻²⁵ has not been tested in a hospital setting and there is no manual available from the T-ACE ²⁹.

Hence, the team concluded that only the AUDIT-C ¹⁰⁻¹², TWEAK ³⁰ and Five Shot ²⁵ could be further evaluated in the next steps. The TWEAK was only available in English, but translated by a certified medical translator working for One Hour Translation (onehourtranslation.com) into Dutch using the forward-backward methodology in line with the guidelines of the Professional Society for Health Economics and Outcomes Research (ISPOR) for translation of patient reported outcome measures ³¹.

STEP 3: PILOTING OF THE THREE SELECTED INSTRUMENTS BY NURSES

METHODS

Four nurses working at the heart transplantation ward or outpatient clinic of the University Hospitals of Leuven (Belgium) volunteered to use the three selected screening instruments (AUDIT-C ¹⁰⁻¹², Five Shot ²⁵, TWEAK ³⁰) in a convenience sample of up to ten adult stable heart transplant patients each. Patients were informed that nurses were piloting instruments and that their responses would not be recorded. Nurses could document their remarks on the content and use of the questionnaires on a standardized sheet provided by the researchers.

Afterwards, we conducted a qualitative study using a phenomenological approach, aiming to understand nurses' experiences when using these screening tools. A topic guide was developed prior to the interviews, addressing questions regarding the formulation of the items, ease of scoring, perceived length for completion, what they expect from a good screening instrument, and their knowledge about the current guidelines on alcohol use, the definition of at risk drinking and the definition of a standard drink. The interview concluded by asking them to provide a rank order from the most liked to the least preferred

instrument. Interviews were audiotaped and anonymized, ensuring confidentiality of information given by participating nurses.

Interviews were transcribed verbatim, remarks indicated, and similar remarks across the interviews were subsequently grouped and presented in table format, as well as an indication of the frequency of a given comment.

Results were discussed afterwards during a focus group with an interdisciplinary group of transplant professionals who did not participate in the interview, during which it was decided which instrument would be selected to undergo cognitive debriefings with patients.

RESULTS

The characteristics of the four nurses participating in this step are summarized in **table 2**. The three instruments were presented to 32 patients in total. Three participants did not know the definition of a standard drink and were not aware of the guidelines regarding acceptable alcohol use, indicating a need for further education.

INSERT TABLE 2 ABOUT HERE

Summary of remarks on each of the three screening instruments

AUDIT-C: All nurses evaluated the use and scoring of this instrument as easy. Yet, all participants noted that further screening could not be stopped, even if a patient indicated he or she is never drinking alcohol on the first item. They suggested offering the possibility to skip the remaining questions if the first item indicates no alcohol use. One nurse also indicated that it might be difficult to remember “how often did you have six or more drinks on one occasion”.

Five-Shot: This instrument was also easy to complete, but required more time than the AUDIT-C. Question three (have people annoyed you by criticising your drinking) was also perceived as intrusive and stigmatizing by one nurse, and another nurse indicated that using the same cut-off for men and women was not correct, given the gender-specific guidelines for the definition of at risk drinking.

TWEAK: Although scoring was easy, more time was needed to complete this instrument compared to the other instruments. Yet, several comments on unclear phrasings or vague language were given, and two nurses indicated that it was not possible to indicate complete abstinence based on this instrument.

Selection of preferred instrument

Three out of the four participants selected the AUDIT-C as their most preferred instrument, as it is short, user-friendly and consists of clearly formulated questions (the fourth nurse had a slight preference for the five Shot over the AUDIT-C). Yet, it was suggested to add an introduction, explaining the purpose of this questionnaire, and to also explain what is meant by a standard alcohol unit. During the focus group, the following additional changes were suggested:

- 1) The response option “never” was added to question one (how often did you have a drink containing alcohol in the past year), followed by some probing questions: “Really never? Not even on certain occasions?” to maximize a trustful response.
- 2) The second question (How many standard drinks containing alcohol do you have on a typical day) was replaced by an alternative translation also available in the literature (how many drinks containing alcohol do you have on a typical day when you are drinking), as the latter might circumvent misconceptions regarding the definition of a standard drink.

STEP 4: COGNITIVE DEBRIEFINGS WITH PATIENTS

METHODS

In order to check the clarity of instructions and wording of the modified AUDIT-C, cognitive debriefing interviews were conducted in a convenience sample of heart transplant patients. Eligible patients had to be 18 years or older, have a scheduled visit at the outpatient clinic or were hospitalized for their annual check-up visit, and Dutch speaking, and willing to provide informed consent. A researcher contacted potentially eligible patients by phone 1-3 days before their outpatient clinic visit, explaining the purpose of the study in a standardized way, and exploring their interest to participate. If interested, a time and place for an in-person meeting at the clinic was scheduled. During this encounter, informed consent was asked, after which the researcher completed the instrument, inviting patients to think aloud. This methodology allows patients to verbalize any thoughts, feedback or feelings when being interviewed regarding their alcohol use. Comments after the instructions, or after each question were noted on a standardized sheet and summarized at the end of each interview. For all comments provided, the

researchers evaluated whether changes to the AUDIT-C were needed. Selection of participants continued until no new comments on the clarity of wording or instructions emerged.

RESULTS

In total, 16 patients participated in the cognitive debriefings. Fifteen patients were male, with a median age of 67 years (range: 34 to 85 years), and a median time since transplantation of 13 years (range: from 3 months to 21 years). Six patients were hospitalized at the time of the interviews. All participants considered the introduction as clear, and the majority understood why screening for alcohol use is relevant. Similarly, the questions were considered concise and clear, and were not perceived as intrusive. It was only suggested to clarify what is meant by a “typical day”. This suggestion was integrated in the final version of the AUDIT-C, before carrying out the final step of this project.

STEP 5: IMPLEMENTATION OF THE INSTRUMENT IN CLINICAL PRACTICE

METHODS

Design, sample and setting

This cross-sectional study aimed to implement the AUDIT-C in clinical practice in a convenience sample of heart transplant patients to check the prevalence of at risk drinking. As a secondary aim, we also explored whether at risk drinking was associated with gender, age, post-transplant status, employment status, or educational level. The following inclusion criteria were used: being 18 years or older, Dutch speaking, having a scheduled outpatient follow-up visit or a planned hospitalization at the heart transplant ward for annual in-patient check-up between February 24, 2017 and March 24, 2017, and capable and willing to provide written informed consent.

Variables and measurement

Demographic characteristics, as well as time since transplant were assessed by means of a self-report interview developed for the purpose of this study. **Table 3** provides an overview of the clinical and demographic characteristics collected, as well as their response categories.

INSERT TABLE 3 ABOUT HERE

Patients were also asked to answer the 3 items of the modified version of the AUDIT-C during a brief interview, as described above. The total score on the 3 items ranges from 0 to 12, with a score of 4 or higher for men and a score of 3 or more for women indicating at risk drinking.

Procedure

This study was approved by the ethical committee of the University Hospitals of Leuven. Two students of the Master of Nursing Science program of our university managed the data collection. The Advanced Practice Nurse of the heart transplant program checked all patients with a scheduled in- or outpatient clinic visit during the one-month data collection period for eligibility. The students first explained the purpose of the assessment in a standardized way in a separate room at the ward, and the interview was completed once informed consent was provided. Patients were informed that their responses would not be shared with the transplant team, and that the project was meant to find out whether using the AUDIT-C in clinical practice is feasible and yield trustworthy results.

Analyses

The statistical software program SPSS (version 24; ibm.com) was used for data analysis. Descriptive statistics were used as appropriate, depending on the measurement level and distribution of the data. The proportion of patients with at risk drinking was expressed as a percentage. A Chi-square test was used to explore the association between at risk drinking and respectively gender and employment status. The Mann-Whitney U test was used to explore differences in at risk drinking with respect to age, educational level, and time since transplant, respectively. Significance was set at $p < 0.05$.

RESULTS

Sample characteristics

Within the study period, 176 patients had a scheduled clinic visit, of which 34 did not meet the inclusion criteria. Twelve patients refused to participate, resulting in a total sample of 130 heart transplant patients available for data analysis (91.6% response rate). **Table 3** contains an overview of the sample's demographic and clinical characteristics. The median age was 62 years, 69.2% were married or living together, 50% were retired, and 34.6% had a higher education. Median time since transplant was 9.5 years.

Proportion of patients with at risk drinking

105 of the 130 patients indicated using alcohol (80.8%), of which 36 patients had at risk drinking (i.e. 27.6% of the total sample and 34.3% of those patients admitting drinking alcohol).

Association between demographic characteristics and at risk drinking

As shown in table 3, more men (38.8%) than women (20%) seem to have at risk drinking, yet this trend was not statistically significantly different. No other differences could be observed for any of the other demographic or clinical variables collected.

DISCUSSION

Given that small volumes of alcohol intake can already have adverse health outcomes ^{1, 32}, regular screening in daily clinical practice is indicated. Although many screening instruments exist, it remained unclear which short, validated self-report screening instruments for at risk drinking were most suitable and user-friendly for use in routine post-transplant follow-up. By using a multi-method approach, including a literature search, expert, professionals and patient involvement, we were able to identify the AUDIT-C ¹⁰⁻¹² as the most suitable instrument.

Because of its inherent risk for underreporting, self-report instruments of course cannot replace more reliable alcohol use methods, such as a psychiatric diagnostic interview, or biomarkers, including e.g. gamma-glutamyltransferase (GGT), urinary ethyl glucuronide (uEtG), mean corpuscular volume (MCV) or Carbohydrate deficient transferrin (CDT) ³³⁻³⁴. Yet, these methods are most often used in case of suspected alcohol dependence or abuse, and not to identify all patients with at risk drinking patterns. Moreover, in other chronically ill patient populations, the AUDIT-C showed a high sensitivity compared to diagnostic interviews ^{10, 12}. Although further research is needed, it is therefore likely that the AUDIT-C has good validity in transplant populations also.

In fact, after implementing the AUDIT-C, we observed that roughly one out of three patients who drink alcohol, do so at a level endangering their health. This proportion is five times higher than the 6% reported in the report of the National Health Survey of Belgium ³⁵, yet the latter used different questions. The percentage observed within our heart transplant program is also twice as high as the 15% at risk drinking reported in a recently published meta-analysis in solid organ transplantation ³⁶. Yet, studies almost exclusively focused on liver transplant patients, a population known to include a significant portion of patients with a history of alcohol-related problems who are closely monitored to prevent alcohol use relapse post-transplant. Few studies looked at the prevalence of at risk drinking in other solid organ transplantation. In any case, the high prevalence observed in our heart transplant population flags a need for supportive interventions. The Brief intervention for Hazardous and harmful drinking, a manual for use in primary care, developed by the World Health Organization might present a good starting point in this regard ³⁷.

This study is characterized by a number of strengths, including its systematic, stepwise approach, combining a comprehensive literature search, expert, professional and patient involvement. Although we

evaluated 24 instruments in detail, it is however, possible, that other relevant self-report instruments might have been missed. Moreover, an unambiguous international definition of at risk drinking, as well as a standard alcohol unit, is currently lacking, making it difficult to compare existing instruments and to implement guidelines in transplant routine care. In line with the national guidelines available at the start of the project, we considered drinking more than 3 units daily for men and more than 2 units for women as at risk drinking. With newer evidence emerging, showing that the health risk becomes already apparent at lower levels of alcohol intake ³⁸, the threshold of acceptable alcohol use will most likely be lowered in the near future and will be the same for both sexes. Meanwhile, it is recommended that transplant centers have an agreed upon definition of acceptable alcohol use and a standard alcoholic drink in place to facilitate education, screening and, in case of at risk drinking, supportive interventions. Moreover, future research should focus on selecting an appropriate screening tools to detect harmful alcohol use already prior to transplantation, given that harmful alcohol use can be present in all solid organ transplant candidates and not only in liver transplant candidates, and that its presence often remains unnoticed without formal assessment. We will explore whether the AUDIT-C can be used successfully in transplant candidates also.

To summarize, our rigorous approach enabled us to select a screening instrument that both professionals and patients find acceptable to use within transplant follow-up care. In line with the principles of implementation science, stakeholder involvement is key to realize successful and sustainable changes in clinical practice.

AUTHOR CONTRIBUTION

Lieza Verhalle:	Concept/design of STEP 1 to 4 of the study, data collection, data analysis and interpretation, Drafting of the article
Kristof Van Bockstaele:	Concept/design of STEP 1 to 4 of the study, data collection, data analysis and interpretation, Critical review of the article
Nathalie Duerinckx:	Concept/design of STEP 1 to 5 of the study, data analysis and interpretation, critical review of the article
Jasper Vanhoof:	Concept/design of STEP 1 to 5 of the study, data analysis and interpretation, critical review of the article
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Johan Van Cleemput:	Data interpretation, facilitation of data collection, critical review of the article
Sabine Gryp:	Data interpretation, facilitation of data collection, critical review of the article
Dominica Kums:	Data collection, data interpretation, critically review of article
Katleen De Bondt:	Concept/design of STEP 1 to 5 of the study, data interpretation, critical review of the article
Veronique Schaevers:	Concept/design of STEP 1 to 5 of the study, data interpretation, critical review of the article
Florian Demuynck:	Concept/design of STEP 5 of the study, data collection, data analysis and interpretation, Critical review of the article
Anne Dewispelaere:	Concept/design of STEP 5 of the study, data collection, data analysis and interpretation, critical review of the article
Fabienne Dobbels:	Concept/design of STEP 1-5 of the study, supervising data collection, analysis and coordinating interpretation, co-writing of the article
Transplantation Innovation Team (TRANSIT): all people listed participated in data collection, or participated in meetings focusing on data analysis or interpretation, and reviewed the article	

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TABLE 1 – overview of the instruments identified during the literature search (step 1) and their overall evaluation of potential suitability (step 2):

	Screening of at risk drinking	Number of questions	Manual available	Diagnostic interview*	Settings in which the instrument was tested	Free use in clinical setting	Total score	
Screening test	Yes: 1 No: 0	≤5: 1 >5: 0	Available: 1 Not available: 0		Hospital setting: 1 Not in hospital setting: 0	Free use: 1 No free use: 0	Number of times '1'	Acronym screening test
AUDIT	1	0	1	1 (1)	1 several medical settings	1	5/6	Alcohol Use Disorders Identification Test ¹⁰⁻¹²
AUDIT-C	1	1	1	1 (2)	1 several medical settings	1	6/6	Alcohol Use Disorders Identification Test – Consumption ¹⁰⁻¹²
AUDIT-QF	1	1	No information	0 (3)	0 several emergency services	No information	2/6	Alcohol Use Disorders Identification Test - Quantity Frequency ¹¹
AUDIT-3 or M-SASQ	1	1	1	1 (4)	0 occupational medicine service	No information	4/6	Modified Single Alcohol Screenings Question ¹¹
ASSIST	0	0	1	1 (5)	0 first-line care and emergency services	1	3/6	Alcohol, Smoking and Substance Involvement Screening Test ¹³
ASSIST LITE	0	0	No information	1 (6)	0 general medical settings in first-line care	No information	1/6	Alcohol, Smoking and Substance Involvement Screening Test ¹⁴
BASIC	1	0	No information	1 (7)	1	No information	3/6	(No information on acronym)

					general hospitals and general practioner offices			¹⁵
LAST	0	0	<i>No information</i>	1 (8)	1 general hospitals and general practioner offices	<i>No information</i>	2/6	Lübeck Alcohol Dependence and Abuse Screening Test ¹⁶
MAST	0	0	1	0 (9)	1 first-line care, general and clinical populations	1	3/6	Michigan Alcoholism Screening Test ^{17, 18}
MAST-G	0	0	<i>No information</i>	1 (10)	0 health centra, outpatient clinic general hospital	<i>No information</i>	1/6	Michigan Alcoholism Screening Test - Geriatric Version ¹⁹
BMAST	0	0	<i>No information</i>	1 (9)	1 general hospital, emergency service	<i>No information</i>	2/6	Brief Michigan Alcoholism Screening Test ²⁰
SMAST-13	0	0	1	1 (11)	1 general practioner offices and general hospitals	<i>No information</i>	3/6	Short Michigan Alcoholism Screening Test ²¹
CAGE	0	1	1	1 (12)	1 university, ambulant settings and hospitals	1	5/6	Cutdown, Annoyed, Guilty, Eye-opener ²²
FACE	1	1	<i>No information</i>	1 (13)	0 general practioner offices	1	4/6	Fast Alcohol Consumption Evaluation ²³
FAST	1	1	1	1 (14)	0 several medical settings	1	5/6	Fast Alcohol Screening Test ²⁴⁻²⁵
FIVE-SHOT	1	1	1	1 (14)	1 several medical settings	1	6/6	(<i>No information on acronym</i>) ²⁵
NIAAA-2Q	1	1	<i>No information</i>	0 (15)	1	<i>No information</i>	3/6	National Institute on Alcohol

NIAAA-4Q					university hospital			Abuse and Alcoholism - 2/4 Questions ²⁶
PAT	1	1	1	0 (16)	0 emergency services	<i>No information</i>	3/6	Paddington Alcohol Test ²⁷
RAPS4	0	1	<i>No information</i>	1 (17)	0 emergency services	1	3/6	Rapid Alcohol Problems Screen 4 ²⁸
RAPS4-QF	1	0	<i>No information</i>	1 (17)	1 emergency service, ambulant and clinical settings	<i>No information</i>	3/6	Rapid Alcohol Problems Screen 4 - Quantity Frequency ²⁸
T-ACE	1	1	<i>No information</i>	0 (18)	1 outpatient clinic hospital and surrounding community	1	4/6	Tolerance, Annoyed, Cut-down, Eye-opener ²⁹
TWEAK	1	1	1	1 (19)	1 emergency services, first-line care and clinical setting	1	6/6	Tolerance, Worried, Eye Opener, Amnesia, K/Cut- down ³⁰

* Diagnostic interview: We checked whether the questionnaire has satisfactory psychometric properties, using a formal psycho-diagnostic interview as the gold standard. A sensitivity and specificity of 70% or higher was considered satisfactory. Sensitivity refers to the ability of a given questionnaire to identify those with at-risk drinking correctly (i.e. those that were identified by the diagnostic interview as having at risk drinking) (true positive rate). Specificity is the ability of the questionnaire to identify those without at-risk drinking correctly (as determined by the diagnostic interview) (true negative rate).

TABLE 2 - demographic characteristics nurses:

Demographic characteristics nurses	Total (n=4)
Gender	
Man	0
Woman	4
Age (in years)	
< 40 years	2
41 years or older	2
Education level	
licensed practical/graduate nurse	1
registered nurse/bachelor	1
master	1
phd	1
Ward	
Cardiology/Heart Transplantation Ward	2
Cardiology/Heart Transplantation Day Unit	2
Work experience (in years)	
<10 years	2
10 years or more	2
Experience with screening for alcohol use	
no	0
limited	1
yes	3
How frequently do you expect alcohol problems being present in transplant patients?	
not present	0
rare	3
frequently present	1

TABLE 3 - demographic and clinical characteristics patients:

Demographic and clinical characteristics patients	Total (n=130;100%)
Gender	
Man	96 (73,8%)
Woman	34 (26,2%)
Age (in years)	
Median	62
Interquartile range	21,25
Minimum	21
Maximum	80
Education level (n,%)	
Lower education (high school not completed)	13 (10%)
Moderate education (high school completed or vocational degree)	72 (55,4%)
High education (bachelor degree or higher)	45 (34,6%)
Marital status (n,%)	
Married/legally cohabiting	90 (69,2%)
Unmarried/single	22 (16,9%)
Divorced	12 (9,2%)
Widower/widow	6 (4,6%)
Living alone (n,%)	
No	106 (81,5%)
Yes	24 (18,5%)
Cohabiting (n,%)	
With partner	95 (73,1%)
With someone else than partner	11 (8,5%)
Employment (n, %)	
Employed	25 (19,2%)
Retired	65 (50%)
Disability income	32 (24,6%)
Houseman/-wife / student / volunteer work	5 (3,8%)
Unemployed / looking for a job	3 (1,5%)
Number of years transplanted	
Median	9,5
Interquartile range	13
Minimum	1
Maximum	26
Number of heart transplants (n,%)	
First	127 (97,7%)