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# Patient factors driving overuse of cardiac catheterization: A qualitative study

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## Abstract

*Objectives:*
Overuse of cardiac catheterization for stable coronary artery disease is documented in Germany and other countries, even though percutaneous coronary interventions do not provide a benefit over medical therapy for stable patients. In this study, we aim to understand the patients' perspective in order to identify patient factors that prevent and promote the described overuse.

*Design:*
Our study is an exploratory qualitative interview study with narrative, structured interviews. The interviews were analyzed using qualitative content analysis by Mayring.

*Setting:*
The interviews were conducted in two German teaching practices affiliated to our Institute for General Medicine.

*Participants:*
24 interviews with 25 patients were conducted; 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). All patients were suffering from coronary artery disease and underwent at least one cardiac catheterization. Patients with known anxiety disorders were excluded from the study.

*Results:*
In our interviews we documented a patient-reported overuse of cardiac catheterization. This may be caused by several aspects which we identified as: (1) convenience; (2) lack of knowledge; (3) helplessness; (4) relationship between patient and physician; (5) fear of another cardiac event.

*Conclusions:*
Our main results in patients with CAD show similarities to studies with different patient types, which speaks in favor of a transferability of our findings. Further and detailed research is needed to develop strategies for improved communication between patients and physicians to better educate patients and to show physicians how to reduce anxiety and uncertainties in patients.

## Strengths and limitations of this study

- Limited research focused on patient factors; our study will offer a new perspective on the overuse of cardiac catheterization.
- Preselection of patients by physicians may cause a bias.
- The study will be conducted in one geographical region; it may not be representative for other health systems or areas.
- It is difficult to show processuality, since patients talk about the status quo and past opinions are difficult to reconstruct retrospectively.
- It is not always clear whether the factors we identified always facilitate a potentially unnecessary CC. The factors could also protect patients from undergoing a preventable CC. This depends on the situation and individual aspects.

## Introduction

There is evidence to support that percutaneous coronary interventions (PCI) in patients with stable coronary artery disease (CAD) offer no survival benefit over medical treatment and that benefits regarding angina relief are similar to medical treatment [1, 2]. Despite this, however, patients and physicians agree to elective cardiac catheterization (CC) and possible PCI [3].

Nearly half of the 600 American physicians and other primary care specialists from a study conducted in the US in 2014 stated that they receive at least one patient request for an unnecessary test or procedure per week. 30% of physicians even reported that this happens more than just once a week. [4]. Overuse of CC amounts to 4-18% in the US according to guidelines [5] and has also been reported for Germany in comparison with neighboring countries [6]. Overuse of CC is not only risky for patients, who are subsequently exposed to unnecessary treatment and, in the case of a CC, to avoidable radiation of up to 186 mSV; this was shown in a German study on multiple procedures and cumulative individual radiation exposure in interventional cardiology [7]. It also contributes to a considerable increase in unnecessary healthcare costs: it is assumed that at least $158 billion are spent on unnecessary treatment [8]; in other words, 30% of healthcare expenditures in the United States are preventable [9]. Physicians have been reported to agree with patients' requests for unnecessary procedures [10], which means that patients are thus contributing to unnecessary healthcare expenditures. This complexity is why we need to take a closer look at patient factors to identify barriers and facilitators that promote the overuse of CC in patients with CAD and to understand the influence on patients' adherence, e.g., by means of a stepwise diagnostic approach that is recommended in guidelines for stable CAD. The overarching goal of this study is to identify indications for an adequate intervention in order to reduce patient-driven overuse of CC [11].

## Methods and Analysis

The interviews were conducted in two German teaching practices which are affiliated with our Institute for General Medicine. Teaching physicians asked patients with a history of acute coronary syndrome (ACS) or pre-diagnosed CAD who underwent at least one or, better yet, multiple CC procedures with or without an intervention to voluntarily participate in the study. Patients with known anxiety disorders were excluded. Two patients refused to participate because of a lack of time, 25 patients agreed to the participation and gave written consent. The interviews were arranged by the practice, and contact details were made available to the interviewer, who then contacted the patients by phone. The interviewer was a female researcher (A.H.) with a sociology background who is qualified and experienced in qualitative research methods and interview techniques. Apart from five patients who had previously been contacted by the interviewer by phone, all other patients were new. The interviews were conducted in a separate meeting room or unoccupied treatment room in the practices; only the participant and the interviewer were present. The interviewer introduced herself as a member of the research team from the Institute for General Medicine and project member of the study. She also pointed out that she was not a physician. After conducting 25 interviews, the saturation point was reached and no further patients were contacted. No repeat interviews were conducted. All patients were given the opportunity to receive and review the interview transcripts, but no participant took advantage of this opportunity.

The analysis was carried out in different phases according to a content analysis by Mayring: the interviews were audio recorded and, following a complete transcription of all interviews, the anonymized material was reduced in terms of language by determining evaluation units and categorizing each subject area that represents the substantial meaning of the statements at a higher abstraction level. To remain as close as possible to the meanings of the statements, the frequency of occurrences was not a criterion for the categorization. Each evaluation unit was encoded by two independent raters: the interviewer (A.H.) and a general physician affiliated with the research team of the Institute for General Medicine (D.D.). The computer program atlas.ti (versions 7 and 8) was used to support the analysis. The results of the analysis of the two raters were compared with one another and were used to modify the categorization systems and coding guides, ultimately resulting in a final version (see Appendix 1). After that, the first rater reanalyzed the entire material using the final version of the categorization, which was randomly reviewed by the second rater.

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Medicine at the University of Duisburg-Essen, Germany (15-6448-BO).

## Results

In order to improve readability, only the male form is used in the text, nevertheless all data apply to members of both gender. 24 interviews with 25 patients were conducted; 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). All patients suffered from coronary artery disease and underwent at least one CC. Patients with known anxiety disorders were excluded from the study. For further details regarding the patients cited in this article, see Appendix 2.

Patients described five factors that lead to a patient-reported overuse of CC: convenience; lack of knowledge; helplessness; relationship to (primary care) physician; fear of another cardiac event. These factors are not always highly selective, as will be shown by the complexity of the citations.

Convenience: Patients frequently reported follow-up appointments for the next CC which were specified in the medical report after their past CC. At first glance, this may be not a patient factor but instead a health care system factor, because hospitals schedule these appointments automatically. However, these appointments were perceived as a simplification for the patients, who gladly accepted them without taking the need for another CC into consideration:

> *"I cannot list all of them [the CCs]. Nine, it might have been nine or ten, and another one for my leg. […] Those were control examinations. Not because something happened […]. I always asked for a copy of my medical report at the hospital. […] Two or three days before the appointment I called them and asked: 'Is the appointment still scheduled?' It is. And then I say: 'Then I will be there.' I always went to the appointments scheduled in the medical report. […] I never went there because of health complaints." (patient_6)*

It appears that patient_6 wanted to be a 'model patient' and wanted to keep the appointment he was given by accepting the physician's advice unquestioned. The fact that he went to the follow-up appointment without having health complaints shows that he was not aware of the significance and benefit of a CC, which indicates a lack of knowledge about his disease and urgency of the medical treatment. As shown below, patient_2 decided for himself that he really needed the appointment, not based on a medical necessity but rather on his own beliefs.

> *"When I got the medical report, the new appointment was already in it. They just scheduled it. (reads out loud) 'Presuming you agree, we have scheduled an appointment for 18/03/2005.' That was the report dated 08 April and then I was directly// A new appointment was// Well, basically I was fine with that, because it meant that I did not need to make an appointment myself. I always told myself that it is absolutely necessary, so I should go there." (patient_2)*

Just like patient_2, another patient described a kind of simplification by agreeing to undergo an intervention without knowing if he really needed it, because getting an appointment with a cardiologist would have taken some time:

> *"He [the physician] said that it would be better to clarify it [an abnormal ECG], but if I go to the cardiologist, I have to wait a year before I can get an appointment. […] So I said […]: I'll just have another cardiac catheterization, because, let's face it, it is faster. I got an appointment within 14 days and then I had the procedure." (patient_23)*

Lack of knowledge: In addition to making life a little simpler, it is noticeable that the physician gave the patient inadequate advice by ignoring the guideline recommendations of step-wise diagnostics and recommending a potentially unnecessary invasive diagnostic procedure instead. However, owing to a lack of expertise, the patient was unable to make an informed decision about the adequacy of the treatment and opted for the convenient route to a quick but unnecessary procedure. This also represents a rejection of the patient's role by hurrying through the patient status to get results as fast as possible.

The lack of knowledge about the disease and the urgency of treatments is a second factor that drives a potential overuse of CC. This factor contains another element why patients agree to or even request an unnecessary CC: helplessness. Patients simply are not well enough informed about their disease and treatment options because of a lack of information. Patients are unable to adequately evaluate and assess their health situation or the procedures of their treatment. As a kind of co-physician, patients make decisions for themselves, and believe that another CC is absolutely necessary, even if no symptoms or health complaints are present, as confirmed by patient_2. This patient later summarized his situation as a kind of a vicious cycle, further exacerbating the helplessness of his situation: the patient eventually gets stuck in a cycle of recurring appointments.

Furthermore, patients do not ask questions regarding the treatments and do not question the decision for an invasive procedure, because *"the other question is whether I understood everything. […] If they [the physicians] believe it [a CC] has to be done, then they must be right. Questions only ever surfaced later." (patient_08)* Once again it is apparent that patients accept physicians' advice unquestioned, well aware of the fact that they have little understanding about the situation. We identified indicators that may influence such behavior. First, not asking questions about their health may be caused by a disinterest in the disease and treatment, as shown by patient_11, who deliberately was not interested in learning about his disease:

> *"Interviewer: Do you try to get information on your disease, do you read up on it? Patient: Absolutely not! No! I don't want to hear about illnesses. I just don't want to know about that." (patient_11)*

In addition, patients showed their disinterest by not dealing with the details of the invasive treatment and reacting indifferently and impassively to the intervention. This causes them to be oblivious to the terminology used results, which may be yet another reason why patients agree to a CC without asking questions:

> *"Patient: That stinnet or stint or whatever it is called." Interviewer: You mean a stent? Patient: I don't remember things like that. I just don't care!" (patient_14)*

Another reason why patients do not ask questions may be a strong trust in the physicians and the belief that the physicians only want to help the patients; in other words, patients do not believe that physicians have any other motivation than curing the patient.

> *"Above all, that's what I say: They want to help. And the procedure is meant to help. It wouldn't hurt to be a bit more positive. They wouldn't just put you through such a procedure without a good reason. They want to have a look. Thank God this procedure exists." (patient_4)*

Strong trust in physicians is also part of a factor that may promote an overuse of CC: the relationship between a patient and his physician. Patients described their relationship to their primary care physician as being one of confidence: *"I am in the best possible hands." (patient_4); "I do anything she [the primary care physician] says." (patient_9).* It is remarkable that some patients conceded all responsibilities to their physicians. When asked whether he seeked information about this disease independently, one patient answered:

> *"You always hear and read and see things. Basically, I always rely on what the physicians say. It remains to be seen whether they were right. They have already made mistakes in the past." (patient_1)*

More interestingly, however, even a lack of trust in the primary care physician may precipitate an overuse of CC. One patient described a conflict he had between trusting the professional competence of his primary care physician and the hospital physicians that encouraged him to have another catheterization for follow-up purposes. The patient gave the impression of being well informed about a CC, mentioned risks that are associated with a CC, and stated that non-invasive procedures may have had the same significance in diagnosing anomalies. The quote demonstrates his helplessness about whom to follow and how to make the right decision.

> *"Half a year later they sent me an invitation, in fact they had already told me in prior personal conversations that I should go there again to have another cardiac catheterization just to make sure that everything was okay. I then talked to my primary care physician and she advised me against having another CC, because such anomalies can also be discovered in simple examinations like an exercise ECG. And because cardiac catheterization is associated with certain risks. They also told me that in the hospital, but I had my doubts and decided to follow the hospital's recommendation, because they said that they carried out the examination and would recommend having another catheterization based on the findings. I had a slightly better relationship to the hospital, because I had no idea about the subject matter and they had helped me before. Knowing what I know now, I may have decided differently, because I now visit my primary care physician regularly for a check-up […]. I: Does that mean you underwent the cardiac catheterization in hospital […]. What did they find? (03): They did not find anything. Everything was fine." (patient_3)*

In the end, the patient decided to have another CC that did not produce any abnormal findings. Later in the interview he reflected that he would have decided differently with the knowledge he has today, and that his trust in his primary care physician has increased in the meantime:

> *"Eight years later I can imagine that, with all those six-monthly examinations with stress ECGs, that one is sure to notice pain or something like that." (patient_3)*

Fear of another cardiac event: A heart attack or chest pain is perceived as a life-changing experience. Patients expressed several emotions regarding their disease and the treatments, which is another patient factor that drives the overuse of CC. The main emotion is fear in general and fear of another cardiac event in particular. This fear can manifest in different ways: starting with the slight uncertainty of not knowing whether they are making the right decision, which is highly regarded to a lack of knowledge, and ending with panic attacks and fear of death.

Uncertainties come to light when patients talked about diseases in their families or friends. Some patients knew people who had suffered or even died of heart disease, causing them to believe that they will suffer the same fate. As a result, they agreed to undergo further diagnostic procedures in order to prevent such medical histories:

> *"My father had a heart attack, my mother had liver cirrhosis. And now my sister died of breast cancer. She never went to have an examination. My other sister had a cyst in her breast. I always think about that and tell myself: Better have that control examination." (patient_7)*

Mainly elderly patients claimed they were afraid of dying soon, so they aimed to prevent every possible 'risk factor' – defined by the patients themselves. This is similar to a fear of death: *"Before something happens, I prefer to play it safe. I don't have that much time anymore." (patient_6)* This cannot be classified as an acute fear for their lives, but more as a worry about living the rest of their lives in good health. Acute fears for one's life or panic attacks are described in particular shortly after suffering an event. One patient retrospectively described: *"I must say, I feel very well taken care of here. But in the beginning I came here for any- and everything. One feels afraid. It's like having a panic attack." (patient_9)* This is explained by the patients being afraid of another cardiac event. A younger patient who suffered his first heart attack in his mid-40s described feeling vulnerable because he was afraid of a high risk and felt the urge to take action to prevent another cardiac and maybe even life-threating event:

> *"In the beginning I sometimes came back here [in the primary care practice] in the afternoon to have an ECG because I thought it was starting up again. You get completely worked up about it. The body seems to respond to what is going on in the head quite strongly. But then [after the ECG] you get the reassurance: everything is fine. Strangely enough, the feeling was gone after that." (patient_22)*

This trend may lead to a large number of doctor's appointments or, as seen before, to unnecessary CC: Patients want to shake off their fear and live with the certainty that their heart is healthy. To allay their fears, patients actively ask for further CCs.

> *"I once said to myself that I should have another examination, because I had pain here, only here, and only when I did some exercise, when I walked up a hill. I thought there could be no harm in having another examination. But they didn't find anything." (patient_8)*

## Discussion

According to the main results of our study to identify which factors may drive an overuse of CC in patients with CAD, our findings exhibit similarities to results of a systematic review of patient-reported factors influencing the choice and satisfaction regarding contralateral prophylactic mastectomy (CPM) in women with early breast cancer from 2016 involving 17 studies. These results are comparable to our results because of the prophylactic aspect of the two treatments and because both diseases, i.e. breast cancer and heart disease, are frightening for the patients because of the many deaths caused by them. Also, there is no evidence of a survival benefit for PCI in stable CAD or CPM in most patient groups [12]. Ager et al. found that patient-reported reasons for CPM were (1) *fear*: patients were concerned about future breast cancer and women believed that CPM would relieve their concerns; (2) *vulnerability*: patients reported that they felt 'overwhelmingly vulnerable to future cancer'; (3) *survival*: patients reported dying due to metastases and wanted to extend their lives by CPM; (4) *cosmesis*: patients desired breast symmetry; and (5) *influence of others*, subdivided into (a) *physician*: physician advice was reported as being very important, (b) *family and friends*: up to 64% of the patients reported that family and/or friends influenced their decision to have CPM; and (c) *spouse*: 68% of the patients reported that their spouse influenced their decision to have CPM [13]. Apart from point (4) cosmesis, our study identified the same factors for patients with CAD. We did not differentiate between fear, vulnerability and survival, but instead summarized these feelings as emotions, while our CAD patients provided details about the type of fear. Another qualitative study from 2017 that was not included in the review of 11 patients with breast cancer who opted for CPM showed that five factors had an influence on their decision: (1) communication between patient and physician; (2) urging for a decision; (3) significance of being proactive about breast cancer treatment; (4) significance of risk; (5) women's relationship with their breasts [14]. Our study produced similar results. Patients with CAD handled their disease differently depending on the information provided by their physician. Also, patients actively sought invasive diagnostic treatment instead of an alternative treatment – if discussed by the physician – or instead of waiting for a real reason to have the diagnostics. CAD patients were also aware of the risk, but interpreted it differently, just like patients who underwent CPM. The urgency of making a decision for CC or the relationship with their hearts did not play a big role for CAD patients.

Focusing more closely on patients' lack of knowledge and helplessness, a Dutch study in 201 patients with CAD using The Rapid Estimate of Adult Literacy on Medicine, The Newest Vital Sign and The Set of Brief Screening Questions to measure health literacy showed that inadequate health literacy is highly prevalent in patients with CAD: 5% (n= 11) had difficulties understanding and applying health information, 18% (n=34) had inadequate reading skills, and as many as 52% (n=103) had difficulties understanding and applying written information. This is also related to adverse risk profiles [15]. A study conducted by Fowler et al. (2012) about decision-making processes of 472 American medicare patients who underwent elective CAD stenting showed that 14% (n=61) of the patients consulted the internet for information, 29% (n=128) sought advice from two or more physicians about their decision, and 5% (n=22) discussed an alternative intervention like coronary artery bypass surgery or medical treatment [16]. Our interviews produced similar results. Most patients refused to gather information about their disease and the treatment, and only one patient reported seeking a second opinion, and again only one patient reported discussing medical treatment as an alternative before CC. Adequate patient education and specific information are needed to strengthen health literacy in order to support patient's understanding of their disease and to respond adequately to it.

In addition, given fact that patients take advantage of recurring appointments to simplify their life, a typification developed by Friedman and Booth-Kewley found that patients express emotions in type A or type B characteristics. Type A behavioral patterns exhibit characteristics like ambitiousness, impatience or aggressiveness and are strongly aware of time management, as a result of which they were more likely to delay the decision for treatment of cardiac symptoms because they want to circumvent the helplessness of being a patient. In this regard, type B patients were generally described as being more relaxed [17]. We observed that patients exhibiting impatient or quick-tempered characteristics were more likely to undergo potentially unnecessary cardiac catheterizations like they want to "hurry sickness", as Friedman and Rosenman describe, which means, that patients want to play the role of being a patient for as short as possible [18]. They were aware that something had to be done, but wanted to stay in the role of a patient as little as possible: they preferred a quick CC to a long-term medicinal therapy or chose to undergo CC within two weeks rather than pursuing a stepwise diagnostic procedure in a cardiology practice because waiting for an appointment would take a while.

Patients with CAD reported a strong trust in their physicians and the prescribed treatment. While patients believe that their physicians recommend further invasive diagnostic merely because their aim is to heal the patient and provide the most effective treatment, in reality physicians have different motives for proposing CC: A qualitative study from 2007 in 20 cardiologists found that, despite the evidence that PCI does not provide a benefit for patients with stable CAD, cardiologists still believed in the benefits of treating ischemia, especially with drug-eluting stents. Cardiologists were also afraid of regretting not intervening if a cardiac event could be averted and losing a patient as a result. Last, but not least, cardiologists want to fulfil their patients' demand for another CC to alleviate patients' anxieties [10]. The 2014 National Survey of Physicians in 600 practicing physicians in the US found that unnecessary tests and procedures are ordered for physicians' own reassurance. The main reasons for proposing unnecessary tests and procedures included concerns about malpractice issues (52%), just to be safe (36%), and wanting more information for reassurance (30%). Patients' insistence (28%) and the desire to keep patients happy (23%), as well as lack of time for the patients (13%), were described as well [4]. This shows that, contrary to patients' beliefs, physicians do not always aim to provide the best treatment.

Emotions play a big role for patients scheduled to undergo CC. In 1980 Leventhal et al. developed the Common Sense Model (CSM) of illness representations which showed how cognitive factors have an impact on illness coping behaviors. The CSM states that patients basically build their illness representation on their knowledge, but that this also includes emotional components in the form of negative reactions that are reflected in emotions such as fear, anger, or distress [19]. Decision-making is not only a process of cost-benefits analysis: gathering information and the basis of judgment also seem to be dependent from emotions. Emotions affect decision making by influencing the accessibility and evaluation of significant features of the decision situation. In addition, patients who experience negative emotions tend to envision negative outcomes [20]. This is what we observed in our study as well: Patients who are afraid for their lives and who had panic attacks because of their heart disease were more likely to go to the physician more frequently and have more examinations.

It is not always clear whether the factors we identified always facilitate a potentially unnecessary CC. The factors could also protect patients from undergoing a preventable CC. This depends on the situation and individual aspects. This knowledge is important to develop a communication strategy between patients and physicians. Further and detailed research is needed to develop such strategies in order to better educate patients and show physicians how to reduce fears and uncertainties in patients.

## Authors’ contributions

A. Herwig: complemented the study concept, conducted and transcribed the interviews, analyzed the interviews, wrote the first draft of the manuscript.

D. Dehnen: analyzed the interviews.

B. Weltermann: developed the study idea and concept, revised the manuscript.

All authors critically reviewed the first draft and provided feedback on it. All authors read and approved the final manuscript.

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## Competing interests’ statement

The authors declare that they have no competing interests.

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## Data sharing

Data is available on request. Please contact the corresponding author.

## REFERENCES

1 Jeremias A, Kaul S, Rosengart TK, et al. The impact of revascularization on mortality in patients with nonacute coronary artery disease. *Am J Med* 2009;122(2):152–61.

2 Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007;356(15):1503–16.

3 Rothberg MB, Sivalingam SK, Ashraf J, et al. Patients' and cardiologists' perceptions of the benefits of percutaneous coronary intervention for stable coronary disease. *Ann Intern Med* 2010;153(5):307–13.

4 PerryUndem Research/Communication. Unnecessary Tests and Procedures In the Health Care System: What Physicians Say About The Problem, the Causes, and the Solutions. Results from a National Survey of Physicians 2014. Available at: http://www.choosingwisely.org/wp-content/uploads/2015/04/Final-Choosing-Wisely-Survey-Report.pdf Accessed April 10, 2018.

5 Scanlon PJ, Faxon DP, Audet AM, et al. ACC/AHA guidelines for coronary angiography: Executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Coronary Angiography) developed in collaboration with the Society for Cardiac Angiography and Interventions. *Circulation* 1999;99(17):2345–57.

6 Nichols M, Townsend N, Scarborough P, et al. European cardiovascular disease statistics, 2012nd edn. Brussels, Sophia Antipolis: European Heart Network; European Society of Cardiology 2012.

7 Weltermann BM, Rock T, Brix G, et al. Multiple procedures and cumulative individual radiation exposure in interventional cardiology: A long-term retrospective study. *Eur Radiol* 2015;25(9):2567–74.

8 Sutkowi-Hemstreet A, Vu M, Harris R, et al. Adult Patients' Perspectives on the Benefits and Harms of Overused Screening Tests: A Qualitative Study. *J Gen Intern Med* 2015;30(11):1618–26.

9 Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA* 2012;307(14):1513–16.

10 Lin GA, Dudley RA, Redberg RF. Cardiologists' use of percutaneous coronary interventions for stable coronary artery disease. *Arch Intern Med* 2007;167(15):1604–09.

11 Herwig A, Weltermann B. Study protocol for a matter of heart: a qualitative study of patient factors driving overuse of cardiac catheterisation. *BMJ Open* 2017;7(9):e017629.

12 Giuliano AE, Boolbol S, Degnim A, et al. Society of Surgical Oncology: Position statement on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. *Ann Surg Oncol* 2007;14(9):2425–27.

13 Ager B, Butow P, Jansen J, et al. Contralateral prophylactic mastectomy (CPM): A systematic review of patient reported factors and psychological predictors influencing choice and satisfaction. *Breast* 2016;28:107–20.

14 Greener JR, Bass SB, Lepore SJ. Contralateral prophylactic mastectomy: A qualitative approach to exploring the decision making process. *J Psychosoc Oncol* 2018;36(2):145–58.

15 van Schaik TM, Jørstad HT, Twickler TB, et al. Cardiovascular disease risk and secondary prevention of cardiovascular disease among patients with low health literacy. *Neth Heart J* 2017;25(7-8):446–54.

16 Fowler FJ, Gallagher PM, Bynum JPW, et al. Decision-making process reported by Medicare patients who had coronary artery stenting or surgery for prostate cancer. *J Gen Intern Med* 2012;27(8):911–16.

17 Friedman HS, Booth-Kewley S. Personality, type A behavior, and coronary heart disease: The role of emotional expression. *J Pers Soc Psychol* 1987;53(4):783–92.

18 Friedman M, Rosenman RH. Type A behavior and your heart, 1st edn. New York: Knopf 1974.

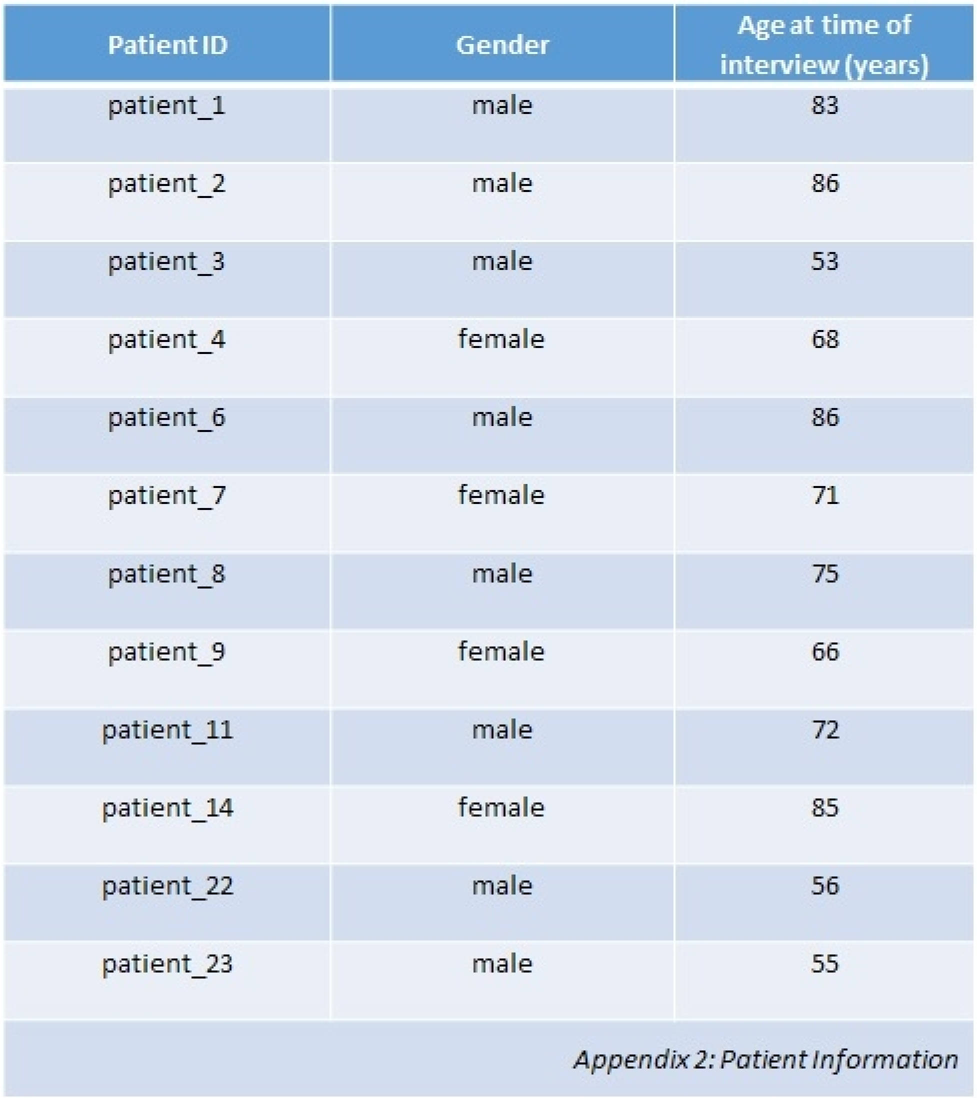
19 Leventhal H, Meyer D, Nerenz D. The Common Sense Representation of Illness Danger. In: Rachman S, ed. Contributions to medical psychology. Oxford: Pergamon 1980:7–30.

20 Schwarz N. Emotion, cognition, and decision making. *Cognition & Emotion* 2000;14(4):433–40.

| Code | Comment |
|---|---|
| 1_physician-patient relationship | Aspects of a relationship between the patient and the physician are discussed. |
| 11_trust in physicians | The patient relies on the physicians' competency. |
| 12_distrust in physicians | The patient does not rely on the physicians' competency. |
| 13_relationship with primary care physician | The patient describes the relationship with her/his primary care physician. |
| 2_cardiac catheterization intervention | General aspects regarding cardiac catheterization (on patients). |
| 21_indication for cardiac catheterization | Reason(s) why the patient underwent cardiac catheterization(s). |
| 22_cardiac catheterization procedure | Aspects regarding the cardiac catheterization procedure on the patient, including complications, side effects and patient's perception. |
| 221_ cardiac catheterization routine for patients | The patient stopped perceiving cardiac catheterization as a special event, it has become a routine. |
| 222_cardiac catheterization routine for physicians | The physician gave the feeling that cardiac catheterization is a routine treatment. |
| 23_overuse of cardiac catheterization | The patient's descriptions suggest an overuse of cardiac catheterization. For example, regarding the intervention, the frequency, and the time between two interventions. |
| 3_patient characteristics | Statements allowing conclusions concerning patient characteristics and potential patient types. |
| 31_patient's health literacy | Aspects that describe the patient's medical knowledge; knowledge of laymen. |
| 312_patient's illness perception | The patient's perception and expectations of the illness and the appraisal of consequences of their treatment. |
| 313_patient's self-diagnosis | The patient explains her/his symptoms by her-/himself without consulting a physician. |
| 314_patient's self-care | The patient treats her/his symptoms by her-/himself without consulting a physician. |
| 32_ symptoms | The patient describes symptoms he/she relates to her/his heart disease. |
| 33_ risk awareness | The patient estimates the risk associated with cardiac catheterization. |
| 34_patient's feelings | Emotions that the patient explicitly verbalizes or shows. |
| 341_fear | The patient expresses fear of the treatment, a new cardiac event, further surgery, or death. |
| 342_uncertainty | The patient is uncertain about her/his treatment or the medical advice received; she/he is unable to appraise whether the treatment decision is correct. |
| 343_ emotional neutrality | The patient describes her/his treatment and overall situation in a rather neutral and unemotional manner. |
| 344_resignation | The patient gave up worrying or caring about his/her disease or future cardiac events and acts indifferently. |
| 345_scepticism | The patient expresses doubts concerning the type of treatment. |
| 35_negative events | The patient experienced negative events related to her/his heart disease and the treatment thereof. |
| 351_negative events regarding cardiac catheterization | Negative incidents that occurred during the cardiac catheterisation, including complications/side-effects and follow-up treatment. |
| 352_negative events in the social network | Negative incidents related to a cardiac catheterization or heart disease in the social network, e.g. family history of heart disease, death of a relative due to myocardial infarction, or death of a friend during cardiac catheterization. |
| 353_negative events regarding other patients | Negative incidents during or related to cardiac catheterization or the heart disease of other patients, e.g. death of a roommate during cardiac catheterization. |
| 354_negative events regarding physicians | Negative incidents related to cardiac catheterization or the heart disease that were caused by a physician. |
| 355_negative events regarding hospitals | Negative incidents related to cardiac catheterization or the heart disease that were caused by the hospital staff. |
| 36_patient's coping strategy | Patient's attempt to process negative events, fears and uncertainties related to the cardiac catheterization or the heart disease. |
| 361_delegation of responsibilities | The patient delegates responsibilities to physicians and other experts by not wanting to know anything about the disease or letting others (e.g. physicians or relatives) decide instead. |
| 362_lifestyle modification | The patient changes her/his lifestyles actively to improve her/his prognosis and prevent further cardiac events. |
| 363_ignoring symptoms | The patient perceives symptoms associated with heart disease, but deliberately ignores them and fails to act adequately, does not listen to her/his body, downplays the symptoms of her/his disease, ignores medical advice, e.g. for a change in lifestyle (continues drinking/smoking). |
| 364_belief in destiny | The patient says that she/he was lucky or talks about destiny or a higher power that saved her/his life. |
| 37_family circumstances | Relationship with the patient's family: the family supports the patient or lets the patient down. |
| 38_Compliance | The patient works together with the physician, follows advice. |
| 39_Non-compliance | The patient does not work together with the physician, does not follow advice. |
| 4_information and patient education | The patient describes situations of information acquisition and patient education regarding her/his heart disease and/or the cardiac catheterization. |
| 41_sources of information | The patient describes different sources of information. |
| 411_soi physician | The patient describes a physician as a source of information. |
| 412_soi social network | The patient describes her/his social network as a source of information. |
| 413_soi other patients | The patient describes other patients as a source of information. |
| 414_soi pharmacy | The patient describes the pharmacy as a source of information. |
| 415_soi television program | The patient describes television programs as a source of information. |
| 416_soi internet | The patient describes the internet as a source of information. |
| 417_soi medical literature | The patient describes medical literature such as books or journal articles as a source of information. |
| 418_soi magazines from pharmacy | The patient describes magazines from pharmacies as a source of information. |
| 419_soi health insurance | The patient describes his health insurance company as a source of information. |
| 420_soi rehab | The patient describes rehab as a source of information. |
| 421_soi physician's report | The patient describes the physician's report as a source of information. |
| 422_soi age/common sense | The patient describes his age or wisdom as a source of information. |
| 43_exchange/contact person within social network | The patient has a contact person within her/his social network with whom she/he can share her/his thoughts related to her/his heart disease. |
| 44_insufficient patient education | The patient lacks information about her/his disease or the cardiac catheterization or would have liked to be given more information about certain topics. |
| 45_physician information | The patient describes what she/he understood and remembers regarding the information provided by the physician on the heart disease or the necessity of the cardiac catheterization. |
| 5_financial aspects | The patient describes financial aspects regarding the treatment received. |
| 6_processuality | The patient now judges her/his treatment and disease differently than at the onset of the disease (or even earlier). |
| 7_organization in hospital/practice/rehab | The patient describes organizational aspects regarding the treatment of the heart disease in hospitals, practices or rehab. |

*Appendix 1: Code Book*

227x841mm (96 x 96 DPI)



| Patient ID | Gender | Age at time of interview (years) |
|---|---|---|
| patient_1 | male | 83 |
| patient_2 | male | 86 |
| patient_3 | male | 53 |
| patient_4 | female | 68 |
| patient_6 | male | 86 |
| patient_7 | female | 71 |
| patient_8 | male | 75 |
| patient_9 | female | 66 |
| patient_11 | male | 72 |
| patient_14 | female | 85 |
| patient_22 | male | 56 |
| patient_23 | male | 55 |

*Appendix 2: Patient Information*

129x146mm (96 x 96 DPI)

# Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Patient factors driving overuse of cardiac catheterization: A qualitative study
Anna Herwig, Dorothea Dehnen, Birgitta Weltermann

| No. Item | Guide questions/description | Reported on Page # |
|---|---|---|
| **Domain 1: Research team and reflexivity** | | |
| *Personal Characteristics* | | |
| 1. Interviewer/facilitator | Which author/s conducted the interview or focus group? | 5 (Methods) |
| 2. Credentials | What were the researcher's credentials? E.g. PhD, MD | 1 |
| 3. Occupation | What was their occupation at the time of the study? | 1, 5 Methods |
| 4. Gender | Was the researcher male or female? | 5 (Methods) |
| 5. Experience and training | What experience or training did the researcher have? | Methods |
| *Relationship with participants* | | |
| 6. Relationship established | Was a relationship established prior to study commencement? | 5 (Methods) |
| 7. Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | 5 (Methods) |
| 8. Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | 5 (Methods) |
| **Domain 2: study design** | | |
| *Theoretical framework* | | |
| 9. Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | 5 (Methods) |
| *Participant selection* | | |
| 10. Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | 5 (Methods) |
| 11. Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | 5 (Methods) |
| 12. Sample size | How many participants were in the study? | 6 (Results) |
| 13. Non-participation | How many people refused to participate or dropped out? Reasons? | 5 (Methods) |
| *Setting* | | |

| | | |
|---|---|---|
| 14. Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | 5 (Methods) |
| 15. Presence of non-participants | Was anyone else present besides the participants and researchers? | 5 (Methods) |
| 16. Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | 5 (Methods), 6 (Results), Appendix 2 |
| *Data collection* | | |
| 17. Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | 5 (Methods) |
| 18. Repeat interviews | Were repeat interviews carried out? If yes, how many? | 5 (Methods) |
| 19. Audio/visual recording | Did the research use audio or visual recording to collect the data? | 5 (Methods) |
| 20. Field notes | Were field notes made during and/or after the interview or focus group? | N/A |
| 21. Duration | What was the duration of the interviews or focus group? | 6 (Results) |
| 22. Data saturation | Was data saturation discussed? | 5 (Methods) |
| 23. Transcripts returned | Were transcripts returned to participants for comment and/or correction? | 5 (Methods) |
| **Domain 3: analysis and findings** | | |
| *Data analysis* | | |
| 24. Number of data coders | How many data coders coded the data? | 5 (Methods) |
| 25. Description of the coding tree | Did authors provide a description of the coding tree? | Appendix 1 |
| 26. Derivation of themes | Were themes identified in advance or derived from the data? | 5 (Methods), 6pp. (Results), Appendix 1 |
| 27. Software | What software, if applicable, was used to manage the data? | Atlas.ti Version 7 & 8 |
| 28. Participant checking | Did participants provide feedback on the findings? | N/A |
| *Reporting* | | |
| 29. Quotations presented | Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number | 6pp. (Results) |
| 30. Data and findings consistent | Was there consistency between the data presented and the findings? | 6pp. (Results) |
| 31. Clarity of major themes | Were major themes clearly presented in the findings? | 6pp. (Results) |
| 32. Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | 11 (Discussion) |

BMJ Open

# Patient factors driving overuse of cardiac catheterization: A qualitative study with 25 participants from two German teaching practices

| | |
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| | |

# Patient factors driving overuse of cardiac catheterization: A qualitative study with 25 participants from two German teaching practices

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**Word count abstract: 244 / 300**

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## Abstract

*Objectives:*

Overuse of cardiac catheterization for stable coronary artery disease is documented in Germany and other countries, although percutaneous coronary interventions do not provide a benefit over medical therapy for stable patients. In this study, we aim to understand patient aspects that influence this overuse.

*Design:*

Our study is an exploratory qualitative interview study with narrative, structured interviews. The interviews were analyzed using qualitative content analysis by Mayring.

*Setting:*

The interviews were conducted in two German teaching practices.

*Participants:*

24 interviews with 25 patients were conducted; 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). All patients were suffering from coronary artery disease and had undergone at least one cardiac catheterization. Patients with known anxiety disorders were excluded from the study.

*Results:*

The analysis identified six patient aspects which contributed to or prevented the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest and/or lack in disease-specific knowledge; (3) helplessness in situations with varying opinions about the care needed; (4) fear of another cardiac event, (5) patient-physician-relationship, and (6) the patient's experience that repetitive interventions did not result in a change of health status or care.

*Conclusions:*

Performed in a country with documented high overuse, we showed that most patients trusted physicians' recommendations, while only few questioned recommended routines. Thus, guideline-based information of patients by physicians, supported by effective health system strategies, is needed to prevent overuse and decrease insecurities on behalf of patients.

### Strengths and limitations of this study

- Limited research focused on patient factors; our study offers a new perspective on the overuse of cardiac catheterization.
- Based on 25 interviews we identified six patient aspects influencing decision making about procedures.
- Preselection of patients by physicians may have caused a bias.
- The study was conducted in one geographical region; it may not be representative for other health care scenarios.
- Overall, patients trusted their physicians and voiced little doubt on their recommendations.

## Introduction

There is evidence that percutaneous coronary intervention (PCI) in patients with stable coronary artery disease (CAD) offers no survival benefit over medical treatment. Also, benefits regarding angina relief are similar to medical treatment [1, 2]. However, various studies show that patients and physicians agree to elective cardiac catheterization (CC) and possible PCI [3].

In 2014, a US national survey with 600 physicians showed that nearly 50% of physicians receive at least one patient request for an unnecessary test or procedure per week. 30% of physicians even reported that this happens more than just once a week [4]. Overuse of CC amounts to 4-18% in the US [5] and is also reported for Germany in comparison with neighboring EU countries [6]. Overuse of CC is not only risky for patients in the short term but is potentially associated with avoidable radiation exposure. A German study on multiple procedures and cumulative individual radiation exposure in interventional cardiology calculated exposures of up to 185 mSV in individuals patients [7]. Also, it is assumed that at least US$158 billion are spent on unnecessary treatments [8], i.e. 30% of healthcare expenditures in the United States are preventable [9]. Physicians have been reported to agree with patients' requests for unnecessary coronary procedures [10] despite guidelines that recommend a stepwise diagnostic approach with non-invasive testing prior to CC for stable coronary disease [5]. While the role of health care systems and physicians has been widely studied [5], little is known on how patients contribute to decisions on unnecessary invasive procedures.

This qualitative study of patients with CAD from German teaching practices aims at identifying patient factors which promote and/or prevent the overuse of CC in stable CAD.

## Methods and Analysis

As detailed in our methods paper [11], we conducted patient interviews in two German teaching practices affiliated with our Institute for General Medicine. Teaching physicians asked patients with a history of acute coronary syndrome (ACS) or known CAD who had undergone at least one or, better yet, multiple CC procedures with or without an intervention for voluntary participation in the study. Patients with known anxiety disorders were excluded to avoid a response bias regarding fears and anxieties. Two patients refused to participate because of lack of time, 25 patients agreed and gave written consent. The interviews were arranged by the practice: contact details were made available to the interviewer who then contacted the patients by phone. The interviewer was a female researcher (A.H.) with a sociology background who is qualified and experienced in qualitative research methods and interview techniques. The interviews were conducted in a treatment or meeting room in the practices with only the participant and the interviewer being present. The interviewer introduced herself as a non-medical member of the research team from the institute and project member of the study. After conducting 25 interviews, the so-called “saturation point” was reached. Methodologically this means that no new aspects regarding the research question were raised in the later. No repeat interviews were conducted. All patients were given the opportunity to receive and review the interview transcripts, but no participant took advantage of this.

### Patient and Public Involvement

The research question was triggered by observations of German general practitioners who reported difficult encounters with asymptomatic CAD patients and their requests demand for invasive rather than non-invasive testing. To better include patients’ views in the interview guide, the interviewing researcher attended a coronary catheterization laboratory for one day where she was given the opportunity to talk to patients before and after their procedures. Beyond this, patients were not involved in the development of the research question or the study design, but were recruited as participants. During the interviews, patients actively took part in the study. Patient representatives will be informed about the study results and asked to support dissemination.

### Analysis

The analysis was carried out in different phases following the methodological approach of a content analysis by Mayring [12]: the interviews were audio recorded and transcribed in full. After anonymization, the language material was reduced by determining evaluation units and categorizing subject areas. Each subject represented a substantial meaning of the statements at a higher abstraction level. To remain as close as possible to the meanings of the statements, the frequency of occurrences was not a criterion for the categorization. Each evaluation unit was encoded by two independent evaluators: the interviewer (A.H.) and a general physician affiliated with the research team of the institute (D.D.). The computer program atlas.ti (versions 7 and 8) was used for the analysis. The results of the analysis by the two evaluators were compared with one another and were used to improve the categorization systems and coding guides. The final version is detailed in Appendix 1. After that, the first evaluators reanalyzed the entire material using the final version of the categorization. A 10% random sample of the coded material was reviewed by the second evaluators to assure coding quality. For details see Appendix 1. To further differentiate factors fostering CC within the specifics of the German health care system, we reanalyzed quotations of aspect 2 (cardiac catheterization intervention) after scientific reviewer comments.

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Medicine at the University of Duisburg-Essen, Germany (15-6448-BO).

## Results

24 interviews with 25 patients were conducted. One interview was conducted with a couple who wished to be interviewed together as both were suffering from CAD. 17 (68%) patients were male, their average age was 73.9 years (range 53-88 years). In total, 16:24:48 hours of interview material was collected with an average duration of 41:02 minutes per interview. The shortest interview lasted 18:12 minutes, the longest 01:18:10 hours. All patients suffered from CAD and had undergone at least one CC. Further details on the patients cited in this article are provided in Appendix 2.

Our first categorization revealed four aspects that influence decision-making regarding CC: 1. physician-patient relationship, 2. issues around CC in Germany, 3. patient characteristics (fear of another cardiac event), 4. patient information (disinterest in and lack of disease-specific lack of knowledge). The reanalysis of the second aspect brought up the following additional aspects: unquestioned acceptance of pre-scheduled appointments, helplessness in situations with varying opinions about the care needed, patients' experiences that repeated interventions did not result in a change of health status or medical care.

Thus, our final analysis comprised the following six patient aspects that promote and/or prevent overuse of CC:

(1) Unquestioned acceptance of pre-scheduled appointments for procedures and convenience,
(2) Helplessness in situations with varying opinions about the care needed,
(3) Disinterest in and lack of disease-specific lack of knowledge,
(4) Fear of another cardiac event,
(5) Relationship between patient and (primary) physician,
(6) Patients' experiences that repeated interventions did not result in a change of health status or medical care.

As outlined in the subsequent citations, several of these aspects typically played a role for each patient. Also, given the complexity of the topic, these aspects are interwoven.

### (1) Unquestioned acceptance of pre-scheduled appointments for procedures/convenience:

Patients reported follow-up appointments for the next CC which were already scheduled and communicated in the medical report after their last CC. This aspect is interesting as it shows the interplay of a health care system factor (hospitals schedule these appointments automatically) and patients' uncritical acceptance. However, these appointments were perceived as a simplification for the patients, who gladly accepted them without taking into consideration the need for another CC:

> *"I cannot list all of them [the CCs]. Nine, it might have been nine or ten, and another one for my leg. […] Those were control examinations. Not because something happened […]. I always asked for a copy of my medical report at the hospital. […] Two or three days before the appointment I called them and asked: 'Is the appointment still scheduled?' It is. And then I said: 'Then I will be there.' I always went to the appointments scheduled in the medical report. […] I never went there because of current health complaints." (patient_6)*

It appears that patient_6 wanted to be a 'model patient' and wanted to keep the appointment he was given by accepting the physician's advice unquestioned. The fact that he went to the follow-up appointment without actually having health complaints shows a misconception about the need for CC. As shown below, patient_2 decided for himself that he really needed the appointment, not based on a medical requirement but rather on his own beliefs, although some subtle doubt remained:

> *"When I got the medical report, the new appointment was already in it. They just scheduled it. (reads out loud) 'Presuming you agree, we have scheduled an appointment for 18/03/2005.' That was the report dated 08 April and then I was directly// A new appointment was// Well, basically I was fine with that, because it meant that I did not need to make an appointment myself. I always told myself that it is absolutely necessary, so I should go there." (patient_2)*

Similar to patient_2, another patient described a kind of convenience by agreeing to undergo an intervention without knowing if he really needed it, because getting an appointment with a cardiologist would have taken some time:

> *"He [the physician] said that it would be better to clarify it [an abnormal ECG], but if I go to the cardiologist, I have to wait a year before I can get an appointment. […] So I said […]: I'll just have another cardiac catheterization, because, let's face it, it is faster. I got an appointment within 14 days and then I had the procedure." (patient_23)*

### (2) Helplessness in situations with varying opinions about the care needed:

Patients reported differences in recommendations between hospitals and primary care physicians. One patient described a conflict he experienced between trusting the professional competence of his primary care physician and the hospital physicians, who encouraged him to have another catheterization for follow-up purposes. The patient appeared to be well informed about CC, mentioned risks that are associated with CC, and stated that non-invasive procedures may have been just as effective in diagnosing anomalies. The following quote demonstrates his helplessness about whose advice to follow and how to make the right decision.

> *"Half a year later they sent me an invitation, in fact they had already told me in prior personal conversations that I should go there again to have another cardiac catheterization just to make sure that everything was okay. I then talked to my primary*

> *care physician and she advised me against having another CC, because such anomalies can also be discovered in simple examinations like an exercise ECG. And because cardiac catheterization is associated with certain risks. They also told me that in the hospital, but I had my doubts and decided to follow the hospital's recommendation, because they said that they carried out the examination and would recommend having another catheterization based on the findings. I had a slightly better relationship to the hospital, because I had no idea about the subject matter and they had helped me before. Knowing what I know now, I may have decided differently, because I now visit my primary care physician regularly for a check-up […]. I: Does that mean you underwent the cardiac catheterization in hospital […]. What did they find? (03): They did not find anything. Everything was fine." (patient_3)*

### (3) Disinterest in and lack of disease-specific knowledge:

Some patients did not ask questions about their health because of disinterest in the disease and treatment, as illustrated by patient_11, who had deliberately decided not to learn about his disease:

> *"Interviewer: Do you try to get information on your disease, do you read up on it? Patient: Absolutely not! No! I don't want to hear about illnesses. I just don't want to know about that stuff." (patient_11)*

In addition, patients showed their disinterest by not dealing with the details of the invasive procedure and by reacting indifferently and impassively to the intervention. This refusal to accept the role of a competent patient who acts as an informed decision-maker is also reflected by a lack of knowledge of the medical terminology used:

> *"Patient: That stinnet or stint or whatever it is called." Interviewer: You mean a stent? Patient: I don't remember things like that. I just don't care!" (patient_14)*

Patients often reported that they did not ask questions about the treatments and did not question the decision for an invasive procedure, because

> *"the other question is whether I understood everything. […] If they [the physicians] believe it [a CC] has to be done, then they must be right. Questions only ever came up later." (patient_08)*

Once again it becomes apparent that patients accepted physicians' advice unquestioned and were well aware of the fact that they did not fully understand the situation. This combination, i.e. patients' lack of information and healthcare system-driven physician factors (insufficient information about guideline-recommended approaches and physicians' preferences towards interventional procedures),) increases the risk of overuse. Patient_2 summarized his situation as a kind of a vicious cycle, illustrating the helplessness of his situation:

> *"Soon I was in that treadmill."*

The patient eventually got stuck in a cycle of recurring interventions.

### (4) Fear of another cardiac event:

A heart attack or chest pain was described as a life-changing experience. Patients expressed several emotions regarding their disease and the treatments. The key emotion described was fear in general and fear of another cardiac event in particular. This fear can manifest in different ways: starting with mild uncertainty of not knowing whether they are making the right decision, which is closely connected to lack of knowledge, and ending with panic attacks and fear of death.

Such fears were described as being increased by experiences of family members or friends. Some patients knew people who had suffered or even died of heart disease. These patients decided in favor of undergoing CC in order to prevent such a fatal outcome:

> *"My father had a heart attack, my mother had liver cirrhosis. And my sister recently died of breast cancer. She never went to have an examination. My other sister had a cyst in her breast. I always think about that and tell myself: Better have that control examination." (patient_7)*

Mainly elderly patients claimed they were afraid of dying soon and therefore attempted to prevent every possible 'risk factor':

> *"Before something happens, I prefer to play it safe. I don't have that much time anymore." (patient_6)*

Other patients reported acute fears for one's life or panic attacks, particulary shortly after suffering an event:

> *"I must say, I feel very well taken care of here. But in the beginning, I came here for any- and everything. One feels afraid. It's like having a panic attack." (patient_9)*

This is explained by the patients being afraid of another cardiac event. A younger patient who suffered his first heart attack in his mid-40s described feeling vulnerable because he was afraid of being a high-risk patient and he felt the need to act in order to prevent another potentially life-threating event:

> *"In the beginning I sometimes came back here [to the primary care practice] in the afternoon to have an ECG because I thought it was starting up again. You get completely worked up about it. The body seems to respond quite strongly to what is going on in the head. But then [after the ECG] you are reassured: everything is fine. Strangely enough, the feeling was gone after that." (patient_22)*

This understandable insecurity was given as a reason leading to a number of physician appointments and to unnecessary CC. Patients reported that they decided in favor of undergoing CC to alleviate their fears and be reassured that their heart is healthy:

> *"I once said to myself that I should have another examination, because I had pain here, only here, and only when I did some exercise, when I walked up a hill. I thought there could be no harm in having another examination. But they didn't find anything." (patient_8)*

### (5) Relationship between patient and (primary) physician:

The relationship between the patient and his physician plays a major role in decision making about care processes. Our patient interviews showed that the trust in the physicians led to overuse as well as prevented it. Patients reported that they did not feel the need to ask questions because of their strong trust in the physicians and the belief that the physicians only want to help them; in other words, patients did not believe that physicians had any other motive than curing them:

> *"Above all, that's what I say: They want to help. And the procedure is meant to help. It wouldn't hurt to be a bit more positive. They wouldn't just put you through such a procedure without a good reason. They want to have a look. Thank God this procedure exists." (patient_4)*

Strong trust in physicians also contributes to a factor that can prevent the overuse of CC. Patients described their relationship to their primary care physician as being one of confidence:

> *"I am in the best possible hands." (patient_4);*

> *"I do anything she [the primary care physician] says." (patient_9).*

When asked whether he searched for information about this disease independently, one patient answered:

> *"You always hear and read and see things. Basically, I always rely on what the physicians say. It remains to be seen whether they were right. They have already made mistakes in the past." (patient_1)*

### (6) Patients' experiences that repeated interventions did not result in a change of health status or medical care:

One patient who had repeatedly undergone six-monthly invasive control angiographies reported his change of mind over time. He reflected that he would have decided differently with his current knowledge, and that his trust in his primary care physician has increased in the meantime:

> *"Eight years later I can imagine that, with all those six-monthly examinations with stress ECGs, you sure notice pain or something like that." (patient_3)*

Another patient realized that following pre-scheduled appointments for procedures did not help him andand did not improve his health status. He learned that a cardiac event and an appropriate intervention would make themselves noticed before they became necessary:

> *"I had just had surgery in 2009 and I said to myself: Now I have some peace. And then I thought: In the last 14 years you have only had these [coronary] repairs. I was literally waiting for the doctor to tell me that I have to have another repair. But they do this only if you actually have severe discomfort. That is what I read between the lines of my primary care physician, because I once asked her: Look, shouldn't I be having another cardiac catheterization? Nope, you don't have any symptoms. Apparently, I would notice when something is about to happen."*

Also, one patient reported that he had had two consecutive CCs, but the physicians found no relevant outcomes. He then decided that he would never undergo such an intervention again:

> *"Interviewer: So, that means you had undergone catheterization twice? patient_12: Two consecutive catheterizations, because apparently they discovered something, but then during the second intervention they found nothing. And then I decided: I will never do this again."*

## Discussion

Our analysis identified six patient aspects which influence the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest and/or lack in disease-specific knowledge; (3) helplessness in situations with varying opinions about the care needed; (4) fear of another cardiac event, (5) patient-physician relationship, and (6) the patient's experience that repeated interventions did not result in a change of health status or care.

Some of our findings are in line with results of a systematic review of 17 studies which addressed patient-reported factors influencing the decision for and the satisfaction regarding contralateral prophylactic mastectomy (CPM) in women with early breast cancer. We chose this comparison as the patients' situations are similar regarding the prophylactic strategy of the intervention with no survival benefit [13]. Also, both diseases, i.e. breast cancer and heart disease, are associated with a risk of recurrence and even death. Ager et al. described five aspects that influenced CPM patients' decision making: (1) *fear:* women were concerned about future breast cancer and believed that CPM would alleviate their concerns; (2) *vulnerability*: patients reported that they felt 'overwhelmingly vulnerable to future cancer'; (3) *presumed survival benefit:* patients who reported concerns about dying from metastases stated that they wished to extend their lives by undergoing CPM; (4) *cosmetics*: patients desired breast symmetry; and (5) *influence of others*, subdivided into (a) *physician's advice*: this was reported as being very important, (b) *family and friends*: up to 64% of the patients reported that these individuals influenced their decision; and (c) *spouse*: 68% of the patients reported that their spouse influenced their decision to have CPM [14]. In agreement with Ager et al. we found that fear and the patient-physician relationship were crucial aspects. The fear of future breast cancer can be considered comparable to the fear of another cardiac event felt by CAD patients. In agreement with this, the influence of physicians and their advice was rated as highly important by both patient groups. In addition, patients undergoing CPM reported that they had been influenced by their spouses or the family, while this aspect did not play a role in our interviews. In contrast to Ager, our study did not differentiate between patients' fears fear and an assumed survival benefit. The issue of an assumed survival benefit was brought up more indirectly: some as some CAD patients reported that they abstained from further interventions as they themselves had observed that the repeated procedures changed neither their health status nor care.

In addition to the findings of Ager et al., a 2017 qualitative study in CPM patients highlighted (1) the importance for patients to be proactive about breast cancer treatment, (2) the urge for a decision, (3) the significance of the patients' risk assessment, and (4) the women's relationship with their breasts [15]. The significance of being proactive about breast cancer treatment can be related to the unquestioned acceptance of pre-scheduled appointments in our study. CAD patients reported feeling good and worrying less about their disease when kept following these appointments. In both diseases, patients report activism, i.e. the acceptance of medical measures rather than abstaining from them, in situations of helplessness (CAD: varying care recommendations given by providers; CPM: urge for a decision in the clinical scenario). In contrast to CPM patients, the individual's relationship to the organ 'heart' did not play aa role in CAD patients.

The CAD patients in our study reported a strong trust in their physicians and the prescribed intervention. Only few patients with recurrent CCs believed them to be inappropriate for their health status and described a change of mind during the course of their disease: while they initially followed the cardiologists' recommendation, they later trusted in the GPs' advice that no further invasive testing was needed. Thus, trust in physicians was initially a promoting aspect, and later became a protecting factor. Interestingly, this reflection was described by patients without further reflecting on potential driving forces on behalf of the cardiologists or the health care system. This is interesting, as our study was conducted in a health care system with known overuse of CC fostered by regional reimbursement strategies [16]. While patients believed that their physicians recommend further invasive diagnostics merely to provide the best care, they did not voice any of the motives that were found in a 2007 qualitative study among 20 Californian cardiologists: despite evidence that PCI does not provide a benefit for patients with stable CAD, cardiologists believed in the benefits of treating ischemia, especially with drug-eluting stents. Also, cardiologists were afraid of later regretting that they did not perform the invasive control if a patient eventually died from CAD. Furthermore, cardiologists wanted to grant their patients' requests for another CC to alleviate patients' anxieties [10]. The 2014 National Survey of Physicians among 600 practicing US physicians confirmed that unnecessary tests and procedures are ordered merely for the physicians' reassurance: reasons included concerns about malpractice issues (52%), just to be safe (36%), and wanting more information to gain certainty (30%). Patients' insistence (28%), the desire to keep patients happy (23%), and a lack of time for the patient (13%) also contributed to this development [4]. It is likely that these physician factors interact with patient factors, e.g. fears and activism, but this could not be analyzed in our study.

In health care scenarios of overuse, it seems obvious to call for better patient education and strategies to strengthen disease-specific health literacy. Focusing on patients' lack of knowledge and helplessness, a Dutch study in 201 CAD patients showed that inadequate health literacy is highly prevalent in patients with CAD: 5% (n= 11) had difficulties understanding and applying health information, 18% (n=34) had inadequate reading skills, and as many as 52% (n=103) had difficulties understanding and applying written information. This was related to cardiovascular outcomes and secondary prevention [17]. The need for better patient education is supported by our study: patients self-reported their lack of disease-specific knowledge and the asymmetry in knowledge and experience between them and the specialist. Because even very well-educated patients need to trust the professionalism of their physicians and their openness about complex scenarios, better health care system regulations, professional activities to promote evidence-based care as well as strategies for better patient participation in decision making are reasonable measures to decrease overuse.

One strength of our study is that is addresses patient factors within the context of CC overuse. However, several study limitations need to be considered. First, the preselection of patients by the family physicians may have caused a bias, although we tried to minimize this bias by selecting a rather large number of patients from two practices with several physicians. Second, the study was conducted in only one region and the results may not necessarily be transferable to other health care scenarios. Third, interviews typically reflected patients' current thoughts, which may not necessarily be consistent with transformation processes they went through during the course of their disease. Future research should address the interplay between physician and patient factors as contributors to overuse.

## Authors’ contributions

A. Herwig: complemented the study concept, conducted and transcribed the interviews, analyzed the interviews, wrote the first draft of the manuscript.

D. Dehnen: analyzed the interviews.

B. Weltermann: developed the study idea and concept, revised the manuscript.

All authors critically reviewed the first draft and provided feedback on it. All authors read and approved the final manuscript.

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## Competing interests’ statement

The authors declare that they have no competing interests.

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## Data sharing

Data is available on request. Please contact the corresponding author.

# REFERENCES

1 Jeremias A, Kaul S, Rosengart TK, et al. The impact of revascularization on mortality in patients with nonacute coronary artery disease. *Am J Med* 2009;122(2):152–61.

2 Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007;356(15):1503–16.

3 Rothberg MB, Sivalingam SK, Ashraf J, et al. Patients' and cardiologists' perceptions of the benefits of percutaneous coronary intervention for stable coronary disease. *Ann Intern Med* 2010;153(5):307–13.

4 PerryUndem Research/Communication. Unnecessary Tests and Procedures In the Health Care System: What Physicians Say About The Problem, the Causes, and the Solutions. Results from a National Survey of Physicians 2014. Available at: http://www.choosingwisely.org/wp-content/uploads/2015/04/Final-Choosing-Wisely-Survey-Report.pdf Accessed April 10, 2018.

5 Scanlon PJ, Faxon DP, Audet AM, et al. ACC/AHA guidelines for coronary angiography: Executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Coronary Angiography) developed in collaboration with the Society for Cardiac Angiography and Interventions. *Circulation* 1999;99(17):2345–57.

6 Nichols M, Townsend N, Scarborough P, et al. European cardiovascular disease statistics, 2012nd edn. Brussels, Sophia Antipolis: European Heart Network; European Society of Cardiology 2012.

7 Weltermann BM, Rock T, Brix G, et al. Multiple procedures and cumulative individual radiation exposure in interventional cardiology: A long-term retrospective study. *Eur Radiol* 2015;25(9):2567–74.

8 Sutkowi-Hemstreet A, Vu M, Harris R, et al. Adult Patients' Perspectives on the Benefits and Harms of Overused Screening Tests: a Qualitative Study. *J Gen Intern Med* 2015;30(11):1618–26.

9 Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA* 2012;307(14):1513–16.

10 Lin GA, Dudley RA, Redberg RF. Cardiologists' use of percutaneous coronary interventions for stable coronary artery disease. *Archives of internal medicine.* 2007;167(15):1604–09.

11 Herwig A, Weltermann B. Study protocol for a matter of heart: a qualitative study of patient factors driving overuse of cardiac catheterisation. *BMJ Open* 2017;7(9):e017629.

12 Mayring P. Qualitative Inhaltsanalyse: Grundlagen und Techniken. s.l.: Beltz Verlagsgruppe 2010.

13 Giuliano AE, Boolbol S, Degnim A, et al. Society of Surgical Oncology: position statement on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. *Ann Surg Oncol* 2007;14(9):2425–27.

14 Ager B, Butow P, Jansen J, et al. Contralateral prophylactic mastectomy (CPM): A systematic review of patient reported factors and psychological predictors influencing choice and satisfaction. *Breast* 2016;28:107–20.

15 Greener JR, Bass SB, Lepore SJ. Contralateral prophylactic mastectomy: A qualitative approach to exploring the decision making process. *J Psychosoc Oncol* 2018;36(2):145–58.

16 Flachskampf FA, Erffa J von, Seligmann C. Reimbursement and the practice of cardiology. *J Am Coll Cardiol* 2012;59(17):1561–65.

17 van Schaik TM, Jørstad HT, Twickler TB, et al. Cardiovascular disease risk and secondary prevention of cardiovascular disease among patients with low health literacy. *Neth Heart J* 2017;25(7-8):446–54.

| Code | Comment |
|---|---|
| **1_physician-patient relationship** | Aspects of a relationship between the patient and the physician are discussed. |
| **11_trust in physicians** | The patient relies on the physicians’ competency. |
| **12_distrust in physicians** | The patient does not rely on the physicians’ competency. |
| **13_relationship with primary care physician** | The patient describes the relationship with her/his primary care physician. |
| **2_cardiac catheterization intervention** | General aspects regarding cardiac catheterization (on patients). |
| **21_indication for cardiac catheterization** | Reason(s) why the patient underwent cardiac catheterization(s). |
| **22_cardiac catheterization procedure** | Aspects regarding the cardiac catheterization procedure on the patient, including complications, side effects and patient’s perception. |
| **221_ cardiac catheterization routine for patients** | The patient stopped perceiving cardiac catheterization as a special event, it has become a routine. |
| **222_cardiac catheterization routine for physicians** | The physician gave the feeling that cardiac catheterization is a routine treatment. |
| **23_overuse of cardiac catheterization** | The patient’s descriptions suggest an overuse of cardiac catheterization. For example, regarding the intervention, the frequency, and the time between two interventions. |
| **3_patient characteristics** | Statements allowing conclusions concerning patient characteristics and potential patient types. |
| **31_patient’s health literacy** | Aspects that describe the patient’s medical knowledge; knowledge of laymen. |
| **312_patient’s illness perception** | The patient’s perception and expectations of the illness and the appraisal of consequences of their treatment. |
| **313_patient’s self-diagnosis** | The patient explains her/his symptoms by her-/himself without consulting a physician. |
| **314_patient’s self-care** | The patient treats her/his symptoms by her-/himself without consulting a physician. |
| **32_ symptoms** | The patient describes symptoms he/she relates to her/his heart disease. |
| **33_ risk awareness** | The patient estimates the risk associated with cardiac catheterization. |
| **34_patient’s feelings** | Emotions that the patient explicitly verbalizes or shows. |

| | |
|---|---|
| **341_fear** | The patient expresses fear of the treatment, a new cardiac event, further surgery, or death. |
| **342_uncertainty** | The patient is uncertain about her/his treatment or the medical advice received; she/he is unable to appraise whether the treatment decision is correct. |
| **343_ emotional neutrality** | The patient describes her/his treatment and overall situation in a rather neutral and unemotional manner. |
| **344_resignation** | The patient gave up worrying or caring about his/her disease or future cardiac events and acts indifferently. |
| **345_scepticism** | The patient expresses doubts concerning the type of treatment. |
| **35_negative events** | The patient experienced negative events related to her/his heart disease and the treatment thereof. |
| **351_negative events regarding cardiac catheterization** | Negative incidents that occurred during the cardiac catheterization, including complications/side-effects and follow-up treatment. |
| **352_negative events in the social network** | Negative incidents related to a cardiac catheterization or heart disease in the social network, e.g. family history of heart disease, death of a relative due to myocardial infarction, or death of a friend during cardiac catheterization. |
| **353_negative events regarding other patients** | Negative incidents during or related to cardiac catheterization or the heart disease of other patients, e.g. death of a roommate during cardiac catheterization. |
| **354_negative events regarding physicians** | Negative incidents related to cardiac catheterization or the heart disease that were caused by a physician. |
| **355_negative events regarding hospitals** | Negative incidents related to cardiac catheterization or the heart disease that were caused by the hospital staff. |
| **36_patient's coping strategy** | Patient's attempt to process negative events, fears and uncertainties related to the cardiac catheterization or the heart disease. |
| **361_delegation of responsibilities** | The patient delegates responsibilities to physicians and other experts by not wanting to know anything about the disease or letting others (e.g. physicians or relatives) decide instead. |
| **362_lifestyle modification** | The patient changes her/his lifestyles actively to improve her/his prognosis and prevent further cardiac events. |
| **363_ignoring symptoms** | The patient perceives symptoms associated with heart disease, but deliberately ignores them and fails to act adequately, does not listen to her/his body, downplays the symptoms of her/his disease, ignores medical advice, e.g. for a change in lifestyle (continues drinking/smoking). |

| | |
|---|---|
| **364_belief in destiny** | The patient says that she/he was lucky or talks about destiny or a higher power that saved her/his life. |
| **37_family circumstances** | Relationship with the patient's family: the family supports the patient or lets the patient down. |
| **38_Compliance** | The patient works together with the physician, follows advice. |
| **39_Non-compliance** | The patient does not work together with the physician, does not follow advice. |
| **4_information and patient education** | The patient describes situations of information acquisition and patient education regarding her/his heart disease and/or the cardiac catheterization. |
| **41_sources of information** | The patient describes different sources of information. |
| **411_soi physician** | The patient describes a physician as a source of information. |
| **412_soi social network** | The patient describes her/his social network as a source of information. |
| **413_soi other patients** | The patient describes other patients as a source of information. |
| **414_soi pharmacy** | The patient describes the pharmacy as a source of information. |
| **415_soi television program** | The patient describes television programs as a source of information. |
| **416_soi internet** | The patient describes the internet as a source of information. |
| **417_soi medical literature** | The patient describes medical literature such as books or journal articles as a source of information. |
| **418_soi magazines from pharmacy** | The patient describes magazines from pharmacies as a source of information. |
| **419_soi health insurance** | The patient describes his health insurance company as a source of information. |
| **420_soi rehab** | The patient describes rehab as a source of information. |
| **421_soi physician's report** | The patient describes the physician's report as a source of information. |
| **422_soi age/common sense** | The patient describes his age or wisdom as a source of information. |
| **43_exchange/contact person within social network** | The patient has a contact person within her/his social network with whom she/he can share her/his thoughts related to her/his heart disease. |

| | |
|---|---|
| **44_insufficient patient education** | The patient lacks information about her/his disease or the cardiac catheterization or would have liked to be given more information about certain topics. |
| **45_physician information** | The patient describes what she/he understood and remembers regarding the information provided by the physician on the heart disease or the necessity of the cardiac catheterization. |
| **5_financial aspects** | The patient describes financial aspects regarding the treatment received. |
| **6_processuality** | The patient now judges her/his treatment and disease differently than at the onset of the disease (or even earlier). |
| **7_organization in hospital/practice/rehab** | The patient describes organizational aspects regarding the treatment of the heart disease in hospitals, practices or rehab. |
| *Appendix 1: Code Book* | |

| Patient ID | Gender | Age at time of interview (years) |
|---|---|---|
| **patient_1** | male | 83 |
| **patient_2** | male | 86 |
| **patient_3** | male | 53 |
| **patient_4** | female | 68 |
| **patient_6** | male | 86 |
| **patient_7** | female | 71 |
| **patient_8** | male | 75 |
| **patient_9** | female | 66 |
| **patient_11** | male | 72 |
| **patient_14** | female | 85 |
| **patient_22** | male | 56 |
| **patient_23** | male | 55 |

*Appendix 2: Patient information*

# Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Patient factors driving overuse of cardiac catheterization: A qualitative study
Anna Herwig, Dorothea Dehnen, Birgitta Weltermann

| No. Item | Guide questions/description | Reported on Page # |
|---|---|---|
| **Domain 1: Research team and reflexivity** | | |
| *Personal Characteristics* | | |
| 1. Interviewer/facilitator | Which author/s conducted the interview or focus group? | 5 (Methods) |
| 2. Credentials | What were the researcher's credentials? E.g. PhD, MD | 1 |
| 3. Occupation | What was their occupation at the time of the study? | 1, 5 Methods |
| 4. Gender | Was the researcher male or female? | 5 (Methods) |
| 5. Experience and training | What experience or training did the researcher have? | Methods |
| *Relationship with participants* | | |
| 6. Relationship established | Was a relationship established prior to study commencement? | 5 (Methods) |
| 7. Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | 5 (Methods) |
| 8. Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | 5 (Methods) |
| **Domain 2: study design** | | |
| *Theoretical framework* | | |
| 9. Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | 5 (Methods) |
| *Participant selection* | | |
| 10. Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | 5 (Methods) |
| 11. Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | 5 (Methods) |
| 12. Sample size | How many participants were in the study? | 6 (Results) |
| 13. Non-participation | How many people refused to participate or dropped out? Reasons? | 5 (Methods) |
| *Setting* | | |

|  |  |  |
|---|---|---|
| 14. Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | 5 (Methods) |
| 15. Presence of non-participants | Was anyone else present besides the participants and researchers? | 5 (Methods) |
| 16. Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | 5 (Methods), 6 (Results), Appendix 2 |
| *Data collection* |  |  |
| 17. Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | 5 (Methods) |
| 18. Repeat interviews | Were repeat interviews carried out? If yes, how many? | 5 (Methods) |
| 19. Audio/visual recording | Did the research use audio or visual recording to collect the data? | 5 (Methods) |
| 20. Field notes | Were field notes made during and/or after the interview or focus group? | N/A |
| 21. Duration | What was the duration of the interviews or focus group? | 6 (Results) |
| 22. Data saturation | Was data saturation discussed? | 5 (Methods) |
| 23. Transcripts returned | Were transcripts returned to participants for comment and/or correction? | 5 (Methods) |
| **Domain 3: analysis and findings** |  |  |
| *Data analysis* |  |  |
| 24. Number of data coders | How many data coders coded the data? | 5 (Methods) |
| 25. Description of the coding tree | Did authors provide a description of the coding tree? | Appendix 1 |
| 26. Derivation of themes | Were themes identified in advance or derived from the data? | 5 (Methods), 6pp. (Results), Appendix 1 |
| 27. Software | What software, if applicable, was used to manage the data? | Atlas.ti Version 7 & 8 |
| 28. Participant checking | Did participants provide feedback on the findings? | N/A |
| *Reporting* |  |  |
| 29. Quotations presented | Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number | 6pp. (Results) |
| 30. Data and findings consistent | Was there consistency between the data presented and the findings? | 6pp. (Results) |
| 31. Clarity of major themes | Were major themes clearly presented in the findings? | 6pp. (Results) |
| 32. Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | 11 (Discussion) |

BMJ Open

# Patient factors driving overuse of cardiac catheterization: A qualitative study with 25 participants from two German teaching practices

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| | |

# Patient factors driving overuse of cardiac catheterization:
# A qualitative study
# with 25 participants from two German teaching practices

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## Abstract

*Objectives:*

Percutaneous coronary interventions do not provide a benefit over medical therapy for stable patients. However, an overuse of cardiac catheterization for stable coronary artery disease is documented in Germany and other countries. In this study, we aim to understand patient factors that influence this overuse.

*Design:*

Our study is an exploratory qualitative interview study with narrative, structured interviews. The interviews were analyzed using qualitative content analysis by Mayring.

*Setting:*

The interviews were conducted in two German teaching practices.

*Participants:*

24 interviews with 25 patients were conducted; 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). All patients suffered from coronary artery disease and had undergone at least one cardiac catheterization. Patients with known anxiety disorders were excluded from the study.

*Results:*

The analysis identified six patient factors which contributed to or prevented the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest in and/or lack of disease-specific knowledge; (3) helplessness in situations with varying opinions on the required care; (4) fear of another cardiac event, (5) patient-physician relationship, and (6) the patient's experience that repeat interventions did not result in a change of health status or care.

*Conclusions:*

Conducted in a country with documented high overuse, we showed that most patients trusted their physicians' recommendations for repeat invasive controls, while only few questioned recommended routines. Thus, guideline-based information of patients by physicians, supported by effective health system strategies, is needed to prevent overuse and decrease patients' insecurities.

## Strengths and limitations of this study

- Until today there has been limited research on patient factors; our study offers a new perspective on the overuse of cardiac catheterization.
- Based on 25 interviews we identified six factors that influence patients' decision making when it comes to procedures.
- The preselection of patients by physicians may have caused a bias.
- The study was conducted in a single geographical region; it may not be representative for other health care systems.
- Overall, patients trusted their physicians and voiced little doubt on their recommendations.

## Introduction

There is evidence that percutaneous coronary intervention (PCI) in patients with stable coronary artery disease (CAD) offers no survival benefit over pharmacological therapy. Furthermore, benefits regarding angina relief are similar to medical therapy [1, 2]. However, various studies show that patients and physicians agree to pursue elective cardiac catheterization (CC) and possible PCI [3] in stable CAD.

In 2014, a US national survey with 600 physicians showed that nearly 50% of physicians were asked for an unnecessary test or procedure by at least one patient per week. 30% of physicians even reported that this happened more than just once a week [4]. Overuse of CC amounts to 4-18% in the US [5] and is also reported for Germany in comparison with neighboring EU countries [6]. Overuse of CC is not only risky for patients in the short term but is potentially associated with avoidable radiation exposure. A German study on multiple procedures and cumulative individual radiation exposure in interventional cardiology calculated exposures of up to 185 mSV in individual patients [7]. Also, it is assumed that at least US$158 billion are spent on unnecessary treatments [8], i.e. 30% of healthcare expenditures in the United States are preventable [9]. Physicians have been reported to follow patients' requests for unnecessary coronary procedures [10] despite guidelines that recommend a stepwise diagnostic approach with non-invasive testing prior to CC for stable coronary disease [5]. While the role of health care systems and physicians has been widely studied [5], little is known on how patients contribute to decisions on unnecessary invasive procedures.

This qualitative study of patients with CAD from German teaching practices aims at identifying patient factors which contribute to and/or prevent the overuse of CC in stable CAD.

## Methods and Analysis

As detailed in our methods paper [11], we conducted patient interviews in two German teaching practices affiliated with our Institute for General Medicine. Teaching physicians asked patients with a history of acute coronary syndrome (ACS) or known CAD who had undergone at least one or, better yet, multiple CC procedures with or without an intervention, for voluntary participation in the study. Patients with known anxiety disorders were excluded to avoid a response bias regarding fears and anxieties. Two patients refused to participate because of lack of time, 25 patients agreed and gave written consent. The interviews were arranged by the practice: contact details were made available to the interviewer who then contacted the patients by phone. The interviewer was a female researcher (A.H.) with a sociology background who is qualified and experienced in qualitative research methods and interview techniques. The interviews were conducted in a treatment or meeting room in the practices with only the participant and the interviewer present. The interviewer introduced herself as a non-medical member of the research team from the institute and a member of the study project. After conducting 25 interviews, the so-called “saturation point” was reached. Methodologically this means that no new contents regarding the research question was recorded during the last interviews. No repeat interviews were conducted. All patients were given the opportunity to review the interview transcripts, but no participant took advantage of this.

### Patient and Public Involvement

The research question was triggered by observations of German general practitioners who reported difficult encounters with asymptomatic CAD patients and their demands for invasive rather than non-invasive testing. To better include patients’ views in the interview guide, the interviewing researcher attended a coronary catheterization laboratory for one day where she was given the opportunity to talk to patients before and after their procedures. Beyond this, patients were not involved in the development of the research question or the study design, but were recruited as participants. During the interviews, patients actively took part in the study. Patient representatives will be informed about the study results and asked to support dissemination.

### Analysis

The analysis was carried out in different stages following the methodological approach of a content analysis by Mayring [12]: the interviews were recorded and transcribed in full. Following anonymization, the language material was reduced by determining evaluation units and by categorizing subject areas. Each subject area represented a substantial meaning of the statements made by the patients at a higher abstraction level. The meaning of the statements, but not the frequency of occurrences was a criterion for the categorization. Each evaluation unit was encoded by two independent evaluators: the interviewer (A.H.) and a general physician affiliated with the research team of the institute (D.D.). The computer program atlas.ti (versions 7 and 8) was used for the analysis. The results of the analysis by the two evaluators were compared with one another and were then used to improve the categorization systems and coding guides. The final version is detailed in Appendix 1. After that, the first evaluator reanalyzed the entire material using the final version of the categorization. A 10% random sample of the coded material was reviewed by the second evaluator to ensure coding quality (see Appendix 1 for details). To further differentiate factors fostering CC within the specifics of the German health care system, we reanalyzed quotations of aspect 2 (cardiac catheterization intervention) after scientific reviewer comments.

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Medicine at the University of Duisburg-Essen, Germany (15-6448-BO).

## Results

24 interviews with 25 patients were conducted. One interview was conducted with a couple who wished to be interviewed together as both were suffering from CAD. 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). In total, 16:24:48 hours of interview material was collected with an average duration of 41:02 minutes per interview. The shortest interview lasted 18:12 minutes, the longest 01:18:10 hours. All patients suffered from CAD and had undergone at least one CC. Further details on the patients cited in this article are provided in Appendix 2.

Our first categorization revealed four factors that influence decision making regarding CC: 1. physician-patient relationship, 2 patient characteristics (fear of another cardiac event), 3. patient information (disinterest in and lack of disease-specific knowledge), and 4. issues relative to CC in Germany, The reanalysis of the fourth factor revealed the three aspects: unquestioned acceptance of pre-scheduled appointments, helplessness in situations with varying opinions on the required level of care, patients' experiences that repeated interventions do not result in a change of health status or medical care. Thus, our final analysis comprised the following six factors that contribute to and/or prevent overuse of CC from a patient's perspective:

(1) Unquestioned acceptance of pre-scheduled appointments for procedures and convenience,
(2) Helplessness in situations with varying opinions on the required level of care,
(3) Disinterest in and lack of disease-specific knowledge,
(4) Fear of another cardiac event,
(5) Relationship between patient and (primary care) physician,
(6) Patients' experiences that repeated interventions do not result in a change of health status or medical care.

As outlined in the subsequent citations, several of these factors typically played a role for each patient. Also, given the complexity of the topic, these aspects may occur simultaneously.

### (1) Unquestioned acceptance of pre-scheduled appointments for procedures/convenience:

Patients reported follow-up appointments for the next CC which were already scheduled and communicated in the medical report after their last CC. This is an interesting observation, as it shows the interplay of a health care system factor (hospitals schedule these appointments automatically) and patients' uncritical acceptance. However, many patients were glad to accept the appointments without questioning the need for another CC, as it meant that they did not have to arrange an appointment themselves:

> *“I can’t possibly list all of them [the CCs]. Nine, maybe I’ve had nine or ten, and another one for my leg. […] Those were all carried out as check-ups and not because something happened […]. I always asked for a copy of my medical report at the hospital. […] Two or three days before the appointment I would call them and ask: ‘Is the appointment still scheduled?’ and they would say ‘Yes, it is’. And then I said: ‘Then I will be there.’ I always went to the appointments scheduled in the medical report. […] I never went because of actual complaints.” (patient_6)*

It appears that patient_6 wanted to be a ‘model patient’ and wanted to keep the appointment given to him by accepting his physician’s advice unquestioned. The fact that he went to the follow-up appointment without actually having any complaints shows that there is a misconception about the need for CC. Below, patient_2 decided for himself that he really needed the appointment, not based on a medical requirement but rather on his own beliefs, although some subtle doubt remained:

> *“When I got the medical report, the new appointment was already in it. They just scheduled it. (Reads out loud.) ‘Presuming you agree, we have scheduled an appointment for 18/03/2005.’ That was the report from the 8th of April and then I was directly// A new appointment was// Well, basically I was fine with all that, because it meant that I did not need to make an appointment myself. I kept telling myself that the appointment was essential and that I should just have it.” (patient_2)*

Similar to patient_2, another patient said that agreeing to have an intervention without knowing if there was really a need for it was as a matter of convenience, because it would have taken him some time to get an appointment with a cardiologist:

> *“He [the physician] said that it would be better to have a closer look at it [an abnormal ECG]. If I go to the cardiologist, I have to wait a year before I can get an appointment. […] So I said […]: I’ll just have another cardiac catheterization, because, let’s be honest, it’s much faster. I got an appointment within 14 days and then I had the procedure.” (patient_23)*

### (2) Helplessness in situations with varying opinions on the required level of care:

Patients reported differences in recommendations between hospitals and primary care physicians. One patient described experiencing a conflict between trusting the professional competence of his primary care physician and the hospital physicians, who encouraged him to undergo re-catheterization for follow-up purposes. The patient appeared to be well informed about CC, talked about risks that are associated with CC, and said that non-invasive procedures may have been just as effective in diagnosing anomalies. The following quote demonstrates his helplessness about whose advice to follow and how to make the right decision:

> *“Half a year later they sent me an invitation, in fact they had already told me before that I should go there again to have another cardiac catheterization just to make sure that*

> *everything was okay. I then talked to my primary care physician and she advised me against having another CC, because those kinds of anomalies can also be discovered in simple examinations like a stress ECG. And because cardiac catheterization is associated with certain risks. They also told me that in hospital, but I was unsure and decided to follow the hospital's recommendation, because they said that they carried out the examination and would recommend having another catheterization based on the findings. I had a slightly better relationship to the hospital, because I had no idea about the subject matter and they had helped me in the past. Knowing what I know now, I may have decided differently, because I now visit my primary care physician for regular check-ups […]. Interviewer: Does that mean you had the cardiac catheterization in hospital […]. What did they find? (3): They didn't find anything. Everything was fine." (patient_3)*

### (3) Disinterest in and lack of disease-specific knowledge:

Some patients did not ask questions about their health because of a lack of interest in the disease and treatment, as illustrated by patient_11, who had deliberately decided not to learn about his disease:

> *"Interviewer: Do you try to get information on your disease, do you read up on it? Patient: Absolutely not! No! I don't want to hear about illnesses. I just don't want to know about that stuff." (patient_11)*

Furthermore, patients showed their disinterest by not dealing with the details of the invasive procedure and by reacting indifferently and impassively to the intervention. This refusal to accept the role of a competent patient who acts as an informed decision-maker is also reflected by a lack of knowledge of the medical terminology used:

> *"Patient: That stinnet or stint or whatever it is called. Interviewer: You mean a stent? Patient: I don't remember things like that. I just don't care!" (patient_14)*

Patients often reported that they did not ask about the treatments and did not question the decision for an invasive procedure, because

> *"The other question is whether I understood everything. […] If they [the physicians] believe that it [a CC] has to be done, then they must be right. Questions only ever came up later." (patient_8)*

Once again it is obvious that patients accepted their physicians' advice unquestioned and were well aware of the fact that they did not fully understand the situation. This combination of factors, i.e. patients' lack of information and health care system-driven physician factors (insufficient information about guideline-recommended approaches and physicians' preferences towards interventional procedures), increases the risk of overuse. Patient_2 described his situation as a kind of a vicious cycle, thus emphasizing the helplessness of his situation:

> *"And soon enough I was going around in circles."*

The patient eventually got stuck in a cycle of recurring interventions.

### (4) Fear of another cardiac event:

A heart attack or chest pain was described as a life-changing experience. Patients expressed different emotions regarding their disease and the treatments. The key emotion described was fear in general and fear of another cardiac event in particular. This fear can manifest in different ways: starting with slight uncertainty about whether they are making the right decision (this, in turn, is closely connected to lack of knowledge), and culminating in panic attacks and fear of death.

Some patients explained that their fears were driven by experiences of family members or friends. Others knew people who had suffered or even died of heart disease. These patients consciously decided in favor of undergoing CC in order to prevent a fatal outcome:

> *"My father had a heart attack, my mother had liver cirrhosis. And my sister recently died of breast cancer. She never went in for a check-up. My other sister had a cyst in her breast. I always think about these things and tell myself: I'd better have the check-up, just to make sure." (patient_7)*

Mainly elderly patients claimed they were afraid of dying soon and were therefore willing to have the examination to prevent possible 'risk factors':

> *"I prefer to play it safe rather than wait for something to happen. I don't have that much time left." (patient_6)*

Other patients reported acute fears for one's life or panic attacks, particularly shortly after suffering an event:

> *"I must say, I feel very well taken care of here. But I used to come here for any- and everything. You just feel scared. It's like having a panic attack." (patient_9)*

This attitude develops from patients' fear of another cardiac event. A younger patient who suffered his first heart attack in his mid-40s described feeling vulnerable because he was afraid of being a high-risk patient and he felt the need to act in order to prevent another potentially life-threating event:

> *"In the past I sometimes came back here [to the primary care practice] in the afternoon to have an ECG simply because I thought it was starting up again. You get so worked up about it. The body seems to respond quite strongly to what is going on in the head. But then [after the ECG] I felt reassured because they would tell me that everything was in order. Strangely enough, the feeling was gone after that." (patient_22)*

This understandable insecurity was cited as one of the factors that drive the high number of doctor's visits and unnecessary CCs. Patients claimed that they decided in favor of undergoing CC to alleviate their fears and be reassured that their heart is healthy:

> *"I once convinced myself that I should have another examination, because I had pain here, only here, and only while I was doing exercise, for example when I walked up a hill. I thought there could be no harm in having another examination. But they didn't find anything." (patient_8)*

### (5) Relationship between patient and (primary care) physician:

The relationship between the patient and his physician played a major role in decision making about care processes. Our patient interviews showed that the patients' trust in their physicians both drove and prevented overuse. Patients reported that they did not feel the need to ask questions because of their strong trust in the physicians and the belief that the physicians was only trying to help them; in other words, patients did not believe that physicians had any motive other than curing them:

> *"Above all, that's what I believe: They just want to help. And the procedure is meant to help. It wouldn't hurt to be a bit more positive. They wouldn't just put you through such an ordeal without good reason. They just want to have a look. Thank God this procedure exists." (patient_4)*

Strong trust in physicians also contributed to a factor that can prevent the overuse of CC. Patients described their relationship to their primary care physician as being one of confidence:

> *"I am in the best possible hands." (patient_4);*
>
> *"I do anything she [the primary care physician] says." (patient_9).*

When asked whether he searched for information about this disease independently, one patient answered:

> *"You always hear and read and see things. Basically, I always rely on what the physicians say. It remains to be seen whether they were right. They have already made mistakes in the past." (patient_1)*

### (6) Patients' experiences that repeat interventions do not result in a change of health status or medical care:

One patient who had repeatedly undergone six-monthly invasive angiographies reported his change of heart over time. He reflected that he would have decided differently with his current knowledge, and that his trust in his primary care physician had increased over the years:

> *"Eight years later I can imagine that, with all those six-monthly examinations with stress ECGs, you would be sure to notice pain or other complaints." (patient_3)*

Another patient realized that merely following pre-scheduled appointments for procedures did not help him and did not improve his health status. He learned that a cardiac event would not go unnoticed and that an appropriate intervention would be found when the time was right:

> *"I had just had surgery in 2009 and I said to myself: Now I have some peace. And then I thought: In the last 14 years you have only had these [coronary] repairs. I was literally waiting for the doctor to tell me that I have to have another repair. But they do this only if you actually have severe discomfort. That is what I read between the lines when I once asked primary care physician: Look, shouldn't I be having another cardiac catheterization? No, you don't have any symptoms. Apparently, I would notice when something is about to happen." (patient_2)*

Also, one patient reported that he had had two consecutive CCs, but the physicians found no relevant outcomes. He then decided that he would never undergo such an intervention again:

> *"Interviewer: That means you underwent catheterization twice? patient_12: Two consecutive catheterizations, because apparently they discovered something, but then during the second intervention they found nothing. And that's when I decided that I would never agree to do this again." (patient_12)*

## Discussion

Our analysis identified six patient factors which influence the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest in and/or lack of disease-specific knowledge; (3) helplessness in situations with varying opinions about the care needed; (4) fear of another cardiac event, (5) patient-physician relationship, and (6) the patient’s experience that repeat interventions do not result in a change of health status or care.

Some of our findings are in line with the results of a systematic review of 17 studies by Ager et al. which addressed patient-reported factors influencing the decision for contralateral prophylactic mastectomy (CPM) in women with early breast cancer. We chose this comparison because the patients’ situations are similar in terms of the intervention strategy offering no survival benefit [13]. Also, both breast cancer and heart disease are associated with a risk of recurrence and even death. In agreement with Ager et al. [14] we found that fear and the patient-physician relationship were crucial factors. Against the backdrop of the fear of disease recurrence, patients with both clinical pictures believed that additional interventions would allay their concerns and even lower their personal risk. In another study of CPM patients, Greener coined this the “significance of patients’ being proactive” about the treatment [15]; to a certain degree, this is similar to the unquestioned acceptance of pre-scheduled appointments in our study. CAD patients reported feeling good and worrying less about their disease if they stuck to the recommended appointments.

The physicians’ influence and their advice were rated as highly important by both patient groups. In addition, patients undergoing CPM reported that they had been influenced by their spouses or the family; in our interviews, however, this did not play a role. Only few patients with repeat CCs believed them to be inappropriate for their health status and described a change of heart during the course of their disease: while they initially followed the cardiologists’ recommendation, they later trusted their GPs’ advice that no further invasive testing was needed. Interestingly, the issue of overuse and the lack of a survival benefit were addressed more indirectly: patients reported that they abstained from further interventions after realizing that the repeat procedures changed neither their health status nor their medical care, yet they did not reflect on potential driving forces on behalf of the cardiologists or the health care system. This is interesting, as our study was conducted in a health care system with known overuse of CC driven by regional reimbursement strategies [16]. Our CAD patients did not voice any of the motives that were identified in a qualitative study among 20 Californian cardiologists in 2007: despite evidence that PCI does not provide a benefit for patients with stable CAD, cardiologists believed in the benefits of treating ischemia, especially with drug-eluting stents. Cardiologists were afraid of regretting their decision not to perform the invasive procedure if a patient died from CAD later on. Also, cardiologists wanted to grant their patients' requests for another CC to alleviate patients' anxieties [10]. A 2014 National Survey of Physicians among 600 practicing US physicians confirmed that unnecessary tests and procedures are ordered merely for the physicians' reassurance: reasons included concerns about malpractice issues (52%), just to be safe (36%), and wanting more information to gain certainty (30%). Patients' insistence (28%), the desire to keep patients happy (23%), and a lack of time for the patient (13%) also contributed to this development [4]. Together with the importance of patients' fears regarding making a decision in favor of (repeat) interventions, these findings are of utmost important, as they suggest a synergy of physician and patient fears/uncertainties as driving factors for overuse.

Focusing on patients' lack of knowledge and helplessness, a Dutch study in 201 CAD patients showed that the prevalence of inadequate health literacy is high in patients with CAD: 5% (n= 11) had difficulties understanding and applying health information, 18% (n=34) had inadequate reading skills, and 52% (n=103) had difficulties understanding and applying written information. This was related to cardiovascular outcomes and secondary prevention [17]. The need for better patient education is supported by our study: patients self-reported their lack of disease-specific knowledge and the difference in knowledge and experience between themselves and the specialist. Because even very well-educated patients need to trust their physicians' professionalism, reasonable measures to decrease overuse include better health care system regulations, professional education to promote evidence-based care, as well as strategies for better patient participation in decision making.

One strength of our study is that it addresses patient factors within the context of CC overuse. However, several study limitations need to be considered. First, the preselection of patients by the family physicians may have caused a bias, although we tried to minimize this bias by selecting a rather large number of patients from two practices with multiple physicians. Second, the study was conducted in only one region and the results may not necessarily be transferable to other health care systems. Third, interviews typically reflected patients' current thoughts, which may not necessarily be consistent with a change of heart that may occur during the course of their disease. Future research should address the interplay between physician and patient factors as contributors to overuse.

## Authors’ contributions

A. Herwig: complemented the study concept, conducted and transcribed the interviews, analyzed the interviews, wrote the first draft of the manuscript.

D. Dehnen: analyzed the interviews.

B. Weltermann: developed the study idea and concept, revised the manuscript.

All authors critically reviewed the first draft and provided feedback on it. All authors read and approved the final manuscript.

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## Competing interests’ statement

The authors declare that they have no competing interests.

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## Data sharing

Data is available on request. Please contact the corresponding author.

# REFERENCES

1 Jeremias A, Kaul S, Rosengart TK, et al. The impact of revascularization on mortality in patients with nonacute coronary artery disease. *Am J Med* 2009;122(2):152–61.

2 Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007;356(15):1503–16.

3 Rothberg MB, Sivalingam SK, Ashraf J, et al. Patients' and cardiologists' perceptions of the benefits of percutaneous coronary intervention for stable coronary disease. *Ann Intern Med* 2010;153(5):307–13.

4 PerryUndem Research/Communication. Unnecessary Tests and Procedures In the Health Care System: What Physicians Say About The Problem, the Causes, and the Solutions. Results from a National Survey of Physicians 2014. Available at: http://www.choosingwisely.org/wp-content/uploads/2015/04/Final-Choosing-Wisely-Survey-Report.pdf Accessed April 10, 2018.

5 Scanlon PJ, Faxon DP, Audet AM, et al. ACC/AHA guidelines for coronary angiography: Executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Coronary Angiography) developed in collaboration with the Society for Cardiac Angiography and Interventions. *Circulation* 1999;99(17):2345–57.

6 Nichols M, Townsend N, Scarborough P, et al. European cardiovascular disease statistics, 2012nd edn. Brussels, Sophia Antipolis: European Heart Network; European Society of Cardiology 2012.

7 Weltermann BM, Rock T, Brix G, et al. Multiple procedures and cumulative individual radiation exposure in interventional cardiology: A long-term retrospective study. *Eur Radiol* 2015;25(9):2567–74.

8 Sutkowi-Hemstreet A, Vu M, Harris R, et al. Adult Patients' Perspectives on the Benefits and Harms of Overused Screening Tests: a Qualitative Study. *J Gen Intern Med* 2015;30(11):1618–26.

9 Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA* 2012;307(14):1513–16.

10 Lin GA, Dudley RA, Redberg RF. Cardiologists' use of percutaneous coronary interventions for stable coronary artery disease. *Archives of internal medicine.* 2007;167(15):1604–09.

11 Herwig A, Weltermann B. Study protocol for a matter of heart: a qualitative study of patient factors driving overuse of cardiac catheterisation. *BMJ Open* 2017;7(9):e017629.

12 Mayring P. Qualitative Inhaltsanalyse: Grundlagen und Techniken. s.l.: Beltz Verlagsgruppe 2010.

13 Giuliano AE, Boolbol S, Degnim A, et al. Society of Surgical Oncology: position statement on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. *Ann Surg Oncol* 2007;14(9):2425–27.

14 Ager B, Butow P, Jansen J, et al. Contralateral prophylactic mastectomy (CPM): A systematic review of patient reported factors and psychological predictors influencing choice and satisfaction. *Breast* 2016;28:107–20.

15 Greener JR, Bass SB, Lepore SJ. Contralateral prophylactic mastectomy: A qualitative approach to exploring the decision making process. *J Psychosoc Oncol* 2018;36(2):145–58.

16 Flachskampf FA, Erffa J von, Seligmann C. Reimbursement and the practice of cardiology. *J Am Coll Cardiol* 2012;59(17):1561–65.

17 van Schaik TM, Jørstad HT, Twickler TB, et al. Cardiovascular disease risk and secondary prevention of cardiovascular disease among patients with low health literacy. *Neth Heart J* 2017;25(7-8):446–54.

| Code | Comment |
|---|---|
| **1_physician-patient relationship** | Aspects of a relationship between the patient and the physician are discussed. |
| **11_trust in physicians** | The patient relies on the physicians' competency. |
| **12_distrust in physicians** | The patient does not rely on the physicians' competency. |
| **13_relationship with primary care physician** | The patient describes the relationship with her/his primary care physician. |
| **2_cardiac catheterization intervention** | General aspects regarding cardiac catheterization (on patients). |
| **21_indication for cardiac catheterization** | Reason(s) why the patient underwent cardiac catheterization(s). |
| **22_cardiac catheterization procedure** | Aspects regarding the cardiac catheterization procedure on the patient, including complications, side effects and patient's perception. |
| **221_ cardiac catheterization routine for patients** | The patient stopped perceiving cardiac catheterization as a special event, it has become a routine. |
| **222_cardiac catheterization routine for physicians** | The physician gave the feeling that cardiac catheterization is a routine treatment. |
| **23_overuse of cardiac catheterization** | The patient's descriptions suggest an overuse of cardiac catheterization. For example, regarding the intervention, the frequency, and the time between two interventions. |
| **3_patient characteristics** | Statements allowing conclusions concerning patient characteristics and potential patient types. |
| **31_patient's health literacy** | Aspects that describe the patient's medical knowledge; knowledge of laymen. |
| **312_patient's illness perception** | The patient's perception and expectations of the illness and the appraisal of consequences of their treatment. |
| **313_patient's self-diagnosis** | The patient explains her/his symptoms by her-/himself without consulting a physician. |
| **314_patient's self-care** | The patient treats her/his symptoms by her-/himself without consulting a physician. |
| **32_ symptoms** | The patient describes symptoms he/she relates to her/his heart disease. |
| **33_ risk awareness** | The patient estimates the risk associated with cardiac catheterization. |
| **34_patient's feelings** | Emotions that the patient explicitly verbalizes or shows. |

| | |
|---|---|
| **341_fear** | The patient expresses fear of the treatment, a new cardiac event, further surgery, or death. |
| **342_uncertainty** | The patient is uncertain about her/his treatment or the medical advice received; she/he is unable to appraise whether the treatment decision is correct. |
| **343_ emotional neutrality** | The patient describes her/his treatment and overall situation in a rather neutral and unemotional manner. |
| **344_resignation** | The patient gave up worrying or caring about his/her disease or future cardiac events and acts indifferently. |
| **345_scepticism** | The patient expresses doubts concerning the type of treatment. |
| **35_negative events** | The patient experienced negative events related to her/his heart disease and the treatment thereof. |
| **351_negative events regarding cardiac catheterization** | Negative incidents that occurred during the cardiac catheterization, including complications/side-effects and follow-up treatment. |
| **352_negative events in the social network** | Negative incidents related to a cardiac catheterization or heart disease in the social network, e.g. family history of heart disease, death of a relative due to myocardial infarction, or death of a friend during cardiac catheterization. |
| **353_negative events regarding other patients** | Negative incidents during or related to cardiac catheterization or the heart disease of other patients, e.g. death of a roommate during cardiac catheterization. |
| **354_negative events regarding physicians** | Negative incidents related to cardiac catheterization or the heart disease that were caused by a physician. |
| **355_negative events regarding hospitals** | Negative incidents related to cardiac catheterization or the heart disease that were caused by the hospital staff. |
| **36_patient's coping strategy** | Patient's attempt to process negative events, fears and uncertainties related to the cardiac catheterization or the heart disease. |
| **361_delegation of responsibilities** | The patient delegates responsibilities to physicians and other experts by not wanting to know anything about the disease or letting others (e.g. physicians or relatives) decide instead. |
| **362_lifestyle modification** | The patient changes her/his lifestyles actively to improve her/his prognosis and prevent further cardiac events. |
| **363_ignoring symptoms** | The patient perceives symptoms associated with heart disease, but deliberately ignores them and fails to act adequately, does not listen to her/his body, downplays the symptoms of her/his disease, ignores medical advice, e.g. for a change in lifestyle (continues drinking/smoking). |

| | |
|---|---|
| **364_belief in destiny** | The patient says that she/he was lucky or talks about destiny or a higher power that saved her/his life. |
| **37_family circumstances** | Relationship with the patient's family: the family supports the patient or lets the patient down. |
| **38_Compliance** | The patient works together with the physician, follows advice. |
| **39_Non-compliance** | The patient does not work together with the physician, does not follow advice. |
| **4_information and patient education** | The patient describes situations of information acquisition and patient education regarding her/his heart disease and/or the cardiac catheterization. |
| **41_sources of information** | The patient describes different sources of information. |
| **411_soi physician** | The patient describes a physician as a source of information. |
| **412_soi social network** | The patient describes her/his social network as a source of information. |
| **413_soi other patients** | The patient describes other patients as a source of information. |
| **414_soi pharmacy** | The patient describes the pharmacy as a source of information. |
| **415_soi television program** | The patient describes television programs as a source of information. |
| **416_soi internet** | The patient describes the internet as a source of information. |
| **417_soi medical literature** | The patient describes medical literature such as books or journal articles as a source of information. |
| **418_soi magazines from pharmacy** | The patient describes magazines from pharmacies as a source of information. |
| **419_soi health insurance** | The patient describes his health insurance company as a source of information. |
| **420_soi rehab** | The patient describes rehab as a source of information. |
| **421_soi physician's report** | The patient describes the physician's report as a source of information. |
| **422_soi age/common sense** | The patient describes his age or wisdom as a source of information. |
| **43_exchange/contact person within social network** | The patient has a contact person within her/his social network with whom she/he can share her/his thoughts related to her/his heart disease. |

| | |
|---|---|
| **44_insufficient patient education** | The patient lacks information about her/his disease or the cardiac catheterization or would have liked to be given more information about certain topics. |
| **45_physician information** | The patient describes what she/he understood and remembers regarding the information provided by the physician on the heart disease or the necessity of the cardiac catheterization. |
| **5_financial aspects** | The patient describes financial aspects regarding the treatment received. |
| **6_processuality** | The patient now judges her/his treatment and disease differently than at the onset of the disease (or even earlier). |
| **7_organization in hospital/practice/rehab** | The patient describes organizational aspects regarding the treatment of the heart disease in hospitals, practices or rehab. |

*Appendix 1: Code Book*

| Patient ID | Gender | Age at time of interview (years) |
|---|---|---|
| **patient_1** | male | 83 |
| **patient_2** | male | 86 |
| **patient_3** | male | 53 |
| **patient_4** | female | 68 |
| **patient_6** | male | 86 |
| **patient_7** | female | 71 |
| **patient_8** | male | 75 |
| **patient_9** | female | 66 |
| **patient_11** | male | 72 |
| **patient_14** | female | 85 |
| **patient_22** | male | 56 |
| **patient_23** | male | 55 |

*Appendix 2: Patient information*

# Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Patient factors driving overuse of cardiac catheterization: A qualitative study
Anna Herwig, Dorothea Dehnen, Birgitta Weltermann

| No. Item | Guide questions/description | Reported on Page # |
|---|---|---|
| **Domain 1: Research team and reflexivity** | | |
| *Personal Characteristics* | | |
| 1. Interviewer/facilitator | Which author/s conducted the interview or focus group? | 5 (Methods) |
| 2. Credentials | What were the researcher's credentials? E.g. PhD, MD | 1 |
| 3. Occupation | What was their occupation at the time of the study? | 1, 5 Methods |
| 4. Gender | Was the researcher male or female? | 5 (Methods) |
| 5. Experience and training | What experience or training did the researcher have? | Methods |
| *Relationship with participants* | | |
| 6. Relationship established | Was a relationship established prior to study commencement? | 5 (Methods) |
| 7. Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | 5 (Methods) |
| 8. Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | 5 (Methods) |
| **Domain 2: study design** | | |
| *Theoretical framework* | | |
| 9. Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | 5 (Methods) |
| *Participant selection* | | |
| 10. Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | 5 (Methods) |
| 11. Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | 5 (Methods) |
| 12. Sample size | How many participants were in the study? | 6 (Results) |
| 13. Non-participation | How many people refused to participate or dropped out? Reasons? | 5 (Methods) |
| *Setting* | | |

| | | |
|---|---|---|
| 14. Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | 5 (Methods) |
| 15. Presence of non-participants | Was anyone else present besides the participants and researchers? | 5 (Methods) |
| 16. Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | 5 (Methods), 6 (Results), Appendix 2 |
| *Data collection* | | |
| 17. Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | 5 (Methods) |
| 18. Repeat interviews | Were repeat interviews carried out? If yes, how many? | 5 (Methods) |
| 19. Audio/visual recording | Did the research use audio or visual recording to collect the data? | 5 (Methods) |
| 20. Field notes | Were field notes made during and/or after the interview or focus group? | N/A |
| 21. Duration | What was the duration of the interviews or focus group? | 6 (Results) |
| 22. Data saturation | Was data saturation discussed? | 5 (Methods) |
| 23. Transcripts returned | Were transcripts returned to participants for comment and/or correction? | 5 (Methods) |
| **Domain 3: analysis and findings** | | |
| *Data analysis* | | |
| 24. Number of data coders | How many data coders coded the data? | 5 (Methods) |
| 25. Description of the coding tree | Did authors provide a description of the coding tree? | Appendix 1 |
| 26. Derivation of themes | Were themes identified in advance or derived from the data? | 5 (Methods), 6pp. (Results), Appendix 1 |
| 27. Software | What software, if applicable, was used to manage the data? | Atlas.ti Version 7 & 8 |
| 28. Participant checking | Did participants provide feedback on the findings? | N/A |
| *Reporting* | | |
| 29. Quotations presented | Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number | 6pp. (Results) |
| 30. Data and findings consistent | Was there consistency between the data presented and the findings? | 6pp. (Results) |
| 31. Clarity of major themes | Were major themes clearly presented in the findings? | 6pp. (Results) |
| 32. Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | 11 (Discussion) |

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# Patient factors driving overuse of cardiac catheterization: A qualitative study with 25 participants from two German teaching practices

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# Patient factors driving overuse of cardiac catheterization:

# A qualitative study

# with 25 participants from two German teaching practices

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## Abstract

*Objectives:*

Percutaneous coronary interventions do not provide a benefit over medical therapy for stable patients. However, an overuse of cardiac catheterization for stable coronary artery disease is documented in Germany and other countries. In this study, we aim to understand patient factors that foster this overuse.

*Design:*

Our study is an exploratory qualitative interview study with narrative, structured interviews. The interviews were analyzed using qualitative content analysis by Mayring.

*Setting:*

The interviews were conducted in two German teaching practices.

*Participants:*

24 interviews with 25 patients were conducted; 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). All patients suffered from coronary artery disease and had undergone at least one cardiac catheterization. Patients with known anxiety disorders were excluded from the study.

*Results:*

The analysis identified six patient factors which contributed to or prevented the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest in and/or lack of disease-specific knowledge; (3) helplessness in situations with varying opinions on the required care; (4) fear of another cardiac event, (5) patient-physician relationship, and (6) the patient's experience that repeat interventions did not result in a change of health status or care.

*Conclusions:*

Conducted in a country with documented overuse of cardiac catheterization, we showed that most patients trusted their physicians' recommendations for repeat coronary angiographies even if they were asymptomatic. Strategies to align physician adherence with guidelines and corresponding patient information are needed to prevent overuse.

## Strengths and limitations of this study

- Until today there has been limited research on patient factors; our study offers a new perspective on the overuse of cardiac catheterization.
- Based on 25 interviews we identified six factors that influence asymptomatic patients' decision making regarding repetitive coronary angiographies.
- The preselection of patients by physicians may have caused a bias.
- The study was conducted in a single geographical region; it may not be representative for other health care systems.
- Overall, patients trusted their physicians and voiced little doubt on their recommendations.

## Introduction

There is evidence that percutaneous coronary intervention (PCI) in patients with stable coronary artery disease (CAD) offers no survival benefit over pharmacological therapy. Furthermore, benefits regarding angina relief are similar to medical therapy [1, 2]. However, various studies show that patients and physicians agree to pursue elective cardiac catheterization (CC) and possible PCI [3] in stable CAD.

In 2014, a US national survey with 600 physicians showed that nearly 50% of physicians were asked for an unnecessary test or procedure by at least one patient per week. 30% of physicians even reported that this happened more than just once a week [4]. Overuse of CC amounts to 4-18% in the US [5] and is also reported for Germany in comparison with neighboring EU countries [6]. Overuse of CC is not only risky for patients in the short term but is potentially associated with avoidable radiation exposure. A German study on multiple procedures and cumulative individual radiation exposure in interventional cardiology calculated exposures of up to 185 mSV in individual patients [7]. Also, it is assumed that at least US$158 billion are spent on unnecessary treatments [8], i.e. 30% of healthcare expenditures in the United States are preventable [9]. Physicians have been reported to follow patients' requests for unnecessary coronary procedures [10] despite guidelines that recommend a stepwise diagnostic approach with non-invasive testing prior to CC for stable coronary disease [5]. While the role of health care systems and physicians has been widely studied [5], little is known on how patients contribute to decisions on unnecessary invasive procedures.

This qualitative study of patients with CAD from German teaching practices aims at identifying patient factors which contribute to and/or prevent the overuse of CC in stable CAD.

## Methods and Analysis

As detailed in our methods paper [11], we conducted patient interviews in two German teaching practices affiliated with our Institute for General Medicine. Teaching physicians asked patients with a history of acute coronary syndrome (ACS) or known CAD who had undergone at least one or, better yet, multiple CC procedures with or without an intervention, for voluntary participation in the study. Patients with known anxiety disorders were excluded to avoid a response bias regarding fears and anxieties. Two patients refused to participate because of lack of time, 25 patients agreed and gave written consent. The interviews were arranged by the practice: contact details were made available to the interviewer who then contacted the patients by phone. The interviewer was a female researcher (A.H.) with a sociology background who is qualified and experienced in qualitative research methods and interview techniques. The interviews were conducted in a treatment or meeting room in the practices with only the participant and the interviewer present. The interviewer introduced herself as a non-medical member of the research team from the institute and a member of the study project. After conducting 25 interviews, the so-called “saturation point” was reached. Methodologically this means that no new contents regarding the research question was recorded during the last interviews. No repeat interviews were conducted. All patients were given the opportunity to review the interview transcripts, but no participant took advantage of this.

### Patient and Public Involvement

The research question was triggered by observations of German general practitioners who reported difficult encounters with asymptomatic CAD patients and their demands for invasive rather than non-invasive testing. To better include patients’ views in the interview guide, the interviewing researcher attended a coronary catheterization laboratory for one day where she was given the opportunity to talk to patients before and after their procedures. Beyond this, patients were not involved in the development of the research question or the study design, but were recruited as participants. During the interviews, patients actively took part in the study. Patient representatives will be informed about the study results and asked to support dissemination.

### Analysis

The analysis was carried out in different stages following the methodological approach of a content analysis by Mayring [12]: the interviews were recorded and transcribed in full. Following anonymization, the language material was reduced by determining evaluation units and by categorizing subject areas. Each subject area represented a substantial meaning of the statements made by the patients at a higher abstraction level. The meaning of the statements, but not the frequency of occurrences was a criterion for the categorization. Each evaluation unit was encoded by two independent evaluators: the interviewer (A.H.) and a general physician affiliated with the research team of the institute (D.D.). The computer program atlas.ti (versions 7 and 8) was used for the analysis. The results of the analysis by the two evaluators were compared with one another and were then used to improve the categorization systems and coding guides. The final version is detailed in Appendix 1. After that, the first evaluator reanalyzed the entire material using the final version of the categorization. A 10% random sample of the coded material was reviewed by the second evaluator to ensure coding quality (see Appendix 1 for details). To further differentiate factors fostering CC within the specifics of the German health care system, we reanalyzed quotations of aspect 2 (cardiac catheterization intervention) after scientific reviewer comments.

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Medicine at the University of Duisburg-Essen, Germany (15-6448-BO).

## Results

24 interviews with 25 patients were conducted. One interview was conducted with a couple who wished to be interviewed together as both were suffering from CAD. 17 (68%) patients were male, the average age was 73.9 years (range 53-88 years). In total, 16:24:48 hours of interview material was collected with an average duration of 41:02 minutes per interview. The shortest interview lasted 18:12 minutes, the longest 01:18:10 hours. All patients suffered from CAD and had undergone at least one CC. Further details on the patients cited in this article are provided in Appendix 2.

Our first categorization revealed four factors that influence decision making regarding CC: 1. physician-patient relationship, 2 patient characteristics (fear of another cardiac event), 3. patient information (disinterest in and lack of disease-specific knowledge), and 4. issues relative to CC in Germany, The reanalysis of the fourth factor revealed the three aspects: unquestioned acceptance of pre-scheduled appointments, helplessness in situations with varying opinions on the required level of care, patients' experiences that repeated interventions do not result in a change of health status or medical care. Thus, our final analysis comprised the following six factors that contribute to and/or prevent overuse of CC from a patient's perspective:

(1) Unquestioned acceptance of pre-scheduled appointments for procedures and convenience,
(2) Helplessness in situations with varying opinions on the required level of care,
(3) Disinterest in and lack of disease-specific knowledge,
(4) Fear of another cardiac event,
(5) Relationship between patient and (primary care) physician,
(6) Patients' experiences that repeated interventions do not result in a change of health status or medical care.

As outlined in the subsequent citations, several of these factors typically played a role for each patient. Also, given the complexity of the topic, these aspects may occur simultaneously.

### (1) Unquestioned acceptance of pre-scheduled appointments for procedures/convenience:

Patients reported follow-up appointments for the next CC which were already scheduled and communicated in the medical report after their last CC. This is an interesting observation, as it shows the interplay of a health care system factor (hospitals schedule these appointments automatically) and patients' uncritical acceptance. However, many patients were glad to accept the appointments without questioning the need for another CC, as it meant that they did not have to arrange an appointment themselves:

> *“I can’t possibly list all of them [the CCs]. Nine, maybe I’ve had nine or ten, and another one for my leg. […] Those were all carried out as check-ups and not because something happened […]. I always asked for a copy of my medical report at the hospital. […] Two or three days before the appointment I would call them and ask: ‘Is the appointment still scheduled?’ and they would say ‘Yes, it is’. And then I said: ‘Then I will be there.’ I always went to the appointments scheduled in the medical report. […] I never went because of actual complaints.” (patient_6)*

It appears that patient_6 wanted to be a ‘model patient’ and wanted to keep the appointment given to him by accepting his physician’s advice unquestioned. The fact that he went to the follow-up appointment without actually having any complaints shows that there is a misconception about the need for CC. Below, patient_2 decided for himself that he really needed the appointment, not based on a medical requirement but rather on his own beliefs, although some subtle doubt remained:

> *“When I got the medical report, the new appointment was already in it. They just scheduled it. (Reads out loud.) ‘Presuming you agree, we have scheduled an appointment for 18/03/2005.’ That was the report from the 8th of April and then I was directly// A new appointment was// Well, basically I was fine with all that, because it meant that I did not need to make an appointment myself. I kept telling myself that the appointment was essential and that I should just have it.” (patient_2)*

Similar to patient_2, another patient said that agreeing to have an intervention without knowing if there was really a need for it was as a matter of convenience, because it would have taken him some time to get an appointment with a cardiologist:

> *“He [the physician] said that it would be better to have a closer look at it [an abnormal ECG]. If I go to the cardiologist, I have to wait a year before I can get an appointment. […] So I said […]: I’ll just have another cardiac catheterization, because, let’s be honest, it’s much faster. I got an appointment within 14 days and then I had the procedure.” (patient_23)*

### (2) Helplessness in situations with varying opinions on the required level of care:

Patients reported differences in recommendations between hospitals and primary care physicians. One patient described experiencing a conflict between trusting the professional competence of his primary care physician and the hospital physicians, who encouraged him to undergo re-catheterization for follow-up purposes. The patient appeared to be well informed about CC, talked about risks that are associated with CC, and said that non-invasive procedures may have been just as effective in diagnosing anomalies. The following quote demonstrates his helplessness about whose advice to follow and how to make the right decision:

> *“Half a year later they sent me an invitation, in fact they had already told me before that I should go there again to have another cardiac catheterization just to make sure that*

> *everything was okay. I then talked to my primary care physician and she advised me against having another CC, because those kinds of anomalies can also be discovered in simple examinations like a stress ECG. And because cardiac catheterization is associated with certain risks. They also told me that in hospital, but I was unsure and decided to follow the hospital's recommendation, because they said that they carried out the examination and would recommend having another catheterization based on the findings. I had a slightly better relationship to the hospital, because I had no idea about the subject matter and they had helped me in the past. Knowing what I know now, I may have decided differently, because I now visit my primary care physician for regular check-ups […]. Interviewer: Does that mean you had the cardiac catheterization in hospital […]. What did they find? (3): They didn't find anything. Everything was fine." (patient_3)*

### (3) Disinterest in and lack of disease-specific knowledge:

Some patients did not ask questions about their health because of a lack of interest in the disease and treatment, as illustrated by patient_11, who had deliberately decided not to learn about his disease:

> *"Interviewer: Do you try to get information on your disease, do you read up on it? Patient: Absolutely not! No! I don't want to hear about illnesses. I just don't want to know about that stuff." (patient_11)*

Furthermore, patients showed their disinterest by not dealing with the details of the invasive procedure and by reacting indifferently and impassively to the intervention. This refusal to accept the role of a competent patient who acts as an informed decision-maker is also reflected by a lack of knowledge of the medical terminology used:

> *"Patient: That stinnet or stint or whatever it is called. Interviewer: You mean a stent? Patient: I don't remember things like that. I just don't care!" (patient_14)*

Patients often reported that they did not ask about the treatments and did not question the decision for an invasive procedure, because

> *"The other question is whether I understood everything. […] If they [the physicians] believe that it [a CC] has to be done, then they must be right. Questions only ever came up later." (patient_8)*

Once again it is obvious that patients accepted their physicians' advice unquestioned and were well aware of the fact that they did not fully understand the situation. This combination of factors, i.e. patients' lack of information and health care system-driven physician factors (insufficient information about guideline-recommended approaches and physicians' preferences towards interventional procedures), increases the risk of overuse. Patient_2 described his situation as a kind of a vicious cycle, thus emphasizing the helplessness of his situation:

> *"And soon enough I was going around in circles."*

The patient eventually got stuck in a cycle of recurring interventions.

### (4) Fear of another cardiac event:

A heart attack or chest pain was described as a life-changing experience. Patients expressed different emotions regarding their disease and the treatments. The key emotion described was fear in general and fear of another cardiac event in particular. This fear can manifest in different ways: starting with slight uncertainty about whether they are making the right decision (this, in turn, is closely connected to lack of knowledge), and culminating in panic attacks and fear of death.

Some patients explained that their fears were driven by experiences of family members or friends. Others knew people who had suffered or even died of heart disease. These patients consciously decided in favor of undergoing CC in order to prevent a fatal outcome:

> *"My father had a heart attack, my mother had liver cirrhosis. And my sister recently died of breast cancer. She never went in for a check-up. My other sister had a cyst in her breast. I always think about these things and tell myself: I'd better have the check-up, just to make sure." (patient_7)*

Mainly elderly patients claimed they were afraid of dying soon and were therefore willing to have the examination to prevent possible 'risk factors':

> *"I prefer to play it safe rather than wait for something to happen. I don't have that much time left." (patient_6)*

Other patients reported acute fears for one's life or panic attacks, particularly shortly after suffering an event:

> *"I must say, I feel very well taken care of here. But I used to come here for any- and everything. You just feel scared. It's like having a panic attack." (patient_9)*

This attitude develops from patients' fear of another cardiac event. A younger patient who suffered his first heart attack in his mid-40s described feeling vulnerable because he was afraid of being a high-risk patient and he felt the need to act in order to prevent another potentially life-threating event:

> *"In the past I sometimes came back here [to the primary care practice] in the afternoon to have an ECG simply because I thought it was starting up again. You get so worked up about it. The body seems to respond quite strongly to what is going on in the head. But then [after the ECG] I felt reassured because they would tell me that everything was in order. Strangely enough, the feeling was gone after that." (patient_22)*

This understandable insecurity was cited as one of the factors that drive the high number of doctor's visits and unnecessary CCs. Patients claimed that they decided in favor of undergoing CC to alleviate their fears and be reassured that their heart is healthy:

> *"I once convinced myself that I should have another examination, because I had pain here, only here, and only while I was doing exercise, for example when I walked up a hill. I thought there could be no harm in having another examination. But they didn't find anything." (patient_8)*

### (5) Relationship between patient and (primary care) physician:

The relationship between the patient and his physician played a major role in decision making about care processes. Our patient interviews showed that the patients' trust in their physicians both drove and prevented overuse. Patients reported that they did not feel the need to ask questions because of their strong trust in the physicians and the belief that the physicians was only trying to help them; in other words, patients did not believe that physicians had any motive other than curing them:

> *"Above all, that's what I believe: They just want to help. And the procedure is meant to help. It wouldn't hurt to be a bit more positive. They wouldn't just put you through such an ordeal without good reason. They just want to have a look. Thank God this procedure exists." (patient_4)*

Strong trust in physicians also contributed to a factor that can prevent the overuse of CC. Patients described their relationship to their primary care physician as being one of confidence:

> *"I am in the best possible hands." (patient_4);*
>
> *"I do anything she [the primary care physician] says." (patient_9).*

When asked whether he searched for information about this disease independently, one patient answered:

> *"You always hear and read and see things. Basically, I always rely on what the physicians say. It remains to be seen whether they were right. They have already made mistakes in the past." (patient_1)*

### (6) Patients' experiences that repeat interventions do not result in a change of health status or medical care:

One patient who had repeatedly undergone six-monthly invasive angiographies reported his change of heart over time. He reflected that he would have decided differently with his current knowledge, and that his trust in his primary care physician had increased over the years:

> *"Eight years later I can imagine that, with all those six-monthly examinations with stress ECGs, you would be sure to notice pain or other complaints." (patient_3)*

Another patient realized that merely following pre-scheduled appointments for procedures did not help him and did not improve his health status. He learned that a cardiac event would not go unnoticed and that an appropriate intervention would be found when the time was right:

> *"I had just had surgery in 2009 and I said to myself: Now I have some peace. And then I thought: In the last 14 years you have only had these [coronary] repairs. I was literally waiting for the doctor to tell me that I have to have another repair. But they do this only if you actually have severe discomfort. That is what I read between the lines when I once asked primary care physician: Look, shouldn't I be having another cardiac catheterization? No, you don't have any symptoms. Apparently, I would notice when something is about to happen." (patient_2)*

Also, one patient reported that he had had two consecutive CCs, but the physicians found no relevant outcomes. He then decided that he would never undergo such an intervention again:

> *"Interviewer: That means you underwent catheterization twice? patient_12: Two consecutive catheterizations, because apparently they discovered something, but then during the second intervention they found nothing. And that's when I decided that I would never agree to do this again." (patient_12)*

## Discussion

Our analysis identified six patient factors which foster the overuse of cardiac catheterization: (1) unquestioned acceptance of pre-scheduled appointments for procedures/convenience; (2) disinterest in and/or lack of disease-specific knowledge; (3) helplessness in situations with varying opinions about the care needed; (4) fear of another cardiac event, (5) patient-physician relationship, and (6) the patient's experience that repeat interventions do not result in a change of health status or care.

Some of our findings are in line with the results of a systematic review of 17 studies by Ager et al. which addressed patient-reported factors influencing the decision for contralateral prophylactic mastectomy (CPM) in women with early breast cancer. We chose this comparison because the patients' situations are similar in terms of the intervention strategy offering no survival benefit [13]. Also, both breast cancer and heart disease are associated with a risk of recurrence and even death. In agreement with Ager et al. [14] we found that fear and the patient-physician relationship were crucial factors. Against the backdrop of the fear of disease recurrence, patients with both clinical pictures believed that additional interventions would allay their concerns and even lower their personal risk. In another study of CPM patients, Greener coined this the "significance of patients' being proactive" about the treatment [15]; to a certain degree, this is similar to the unquestioned acceptance of pre-scheduled appointments in our study. CAD patients reported feeling good and worrying less about their disease if they stuck to the recommended appointments.

The physicians' advice had a high impact in both patient groups. In addition, patients undergoing CPM reported that they had been influenced by their spouses or the family; in our interviews, however, this did not play a role. Only few patients with repeat CCs believed them to be inappropriate for their health status and described a change of heart during the course of their disease: while they initially followed the cardiologists' recommendation, they later trusted their GPs' advice that no further invasive testing was needed. Interestingly, the issue of overuse and the lack of a survival benefit were addressed more indirectly: patients reported that they abstained from further interventions after realizing that the repeat procedures changed neither their health status nor their medical care, yet they did not reflect on potential driving forces on behalf of the cardiologists or the health care system. This is interesting, as our study was conducted in a health care system with known overuse of CC driven by regional reimbursement strategies [16]. Our CAD patients did not voice any of the motives that were identified in a qualitative study among 20 Californian cardiologists in 2007: despite evidence that PCI does not provide a benefit for patients with stable CAD, cardiologists believed in the benefits of treating ischemia, especially with drug-eluting stents. Cardiologists were afraid of regretting their decision not to perform the invasive procedure if a patient died from CAD later on. Also, cardiologists wanted to grant their patients' requests for another CC to alleviate patients' anxieties [10]. A 2014 National Survey of Physicians among 600 practicing US physicians confirmed that unnecessary tests and procedures are ordered merely for the physicians' reassurance: reasons included concerns about malpractice issues (52%), just to be safe (36%), and wanting more information to gain certainty (30%). Patients' insistence (28%), the desire to keep patients happy (23%), and a lack of time for the patient (13%) also contributed to this development [4]. Together with the importance of patients' fears regarding making a decision in favor of (repeat) interventions, these findings are of utmost important, as they suggest a synergy of physician and patient fears/uncertainties as driving factors for overuse.

Focusing on patients' lack of knowledge and helplessness, a Dutch study in 201 CAD patients showed that the prevalence of inadequate health literacy is high in patients with CAD: 5% (n= 11) had difficulties understanding and applying health information, 18% (n=34) had inadequate reading skills, and 52% (n=103) had difficulties understanding and applying written information. This was related to cardiovascular outcomes and secondary prevention [17]. The need for better patient education is supported by our study: patients self-reported their lack of disease-specific knowledge and the difference in knowledge and experience between themselves and the specialist. Because even very well-educated patients need to trust their physicians' professionalism, reasonable measures to decrease overuse include better health care system regulations, professional education to promote evidence-based care, as well as strategies for better patient participation in decision making. In recent years there has been a cultural shift towards shared decision making [18, 19], which means that clinicians and patients make informed decisions together to support patients' involvement and autonomy [20] instead of clinicians merely making decisions on behalf of patients. Screening and diagnostic tests in particular are considered suitable for shared decision making [21]. Our study shows that various anxieties and misconceptions about coronary disease foster patients' consent to unnecessary coronary procedures. Thus, to better implement evidence-based shared decision making for coronary disease, future strategies must consider and address these emotional and educational aspects.

One strength of our study is that it addresses patient factors within the context of CC overuse. However, several study limitations need to be considered. First, the preselection of patients by the family physicians may have caused a bias, although we tried to minimize this bias by selecting a rather large number of patients from two practices with multiple physicians. Second, the study was conducted in only one region and the results may not necessarily be transferable to other health care systems. Third, interviews typically reflected patients' current thoughts, which may not necessarily be consistent with a change of heart that may occur during the course of their disease. Future research should address the interplay between physician and patient factors as contributors to overuse.

## Authors' contributions

A. Herwig: complemented the study concept, conducted and transcribed the interviews, analyzed the interviews, wrote the first draft of the manuscript.

D. Dehnen: analyzed the interviews.

B. Weltermann: developed the study idea and concept, revised the manuscript.

All authors critically reviewed the first draft and provided feedback on it. All authors read and approved the final manuscript.

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## Competing interests' statement

The authors declare that they have no competing interests.

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## Data sharing

Data is available on request. Please contact the corresponding author.

# REFERENCES

1 Jeremias A, Kaul S, Rosengart TK, et al. The impact of revascularization on mortality in patients with nonacute coronary artery disease. *Am J Med* 2009;122(2):152–61.

2 Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007;356(15):1503–16.

3 Rothberg MB, Sivalingam SK, Ashraf J, et al. Patients' and cardiologists' perceptions of the benefits of percutaneous coronary intervention for stable coronary disease. *Ann Intern Med* 2010;153(5):307–13.

4 PerryUndem Research/Communication. Unnecessary Tests and Procedures In the Health Care System: What Physicians Say About The Problem, the Causes, and the Solutions. Results from a National Survey of Physicians 2014. Available at: http://www.choosingwisely.org/wp-content/uploads/2015/04/Final-Choosing-Wisely-Survey-Report.pdf Accessed April 10, 2018.

5 Scanlon PJ, Faxon DP, Audet AM, et al. ACC/AHA guidelines for coronary angiography: Executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Coronary Angiography) developed in collaboration with the Society for Cardiac Angiography and Interventions. *Circulation* 1999;99(17):2345–57.

6 Nichols M, Townsend N, Scarborough P, et al. European cardiovascular disease statistics, 2012nd edn. Brussels, Sophia Antipolis: European Heart Network; European Society of Cardiology 2012.

7 Weltermann BM, Rock T, Brix G, et al. Multiple procedures and cumulative individual radiation exposure in interventional cardiology: A long-term retrospective study. *Eur Radiol* 2015;25(9):2567–74.

8 Sutkowi-Hemstreet A, Vu M, Harris R, et al. Adult Patients' Perspectives on the Benefits and Harms of Overused Screening Tests: a Qualitative Study. *J Gen Intern Med* 2015;30(11):1618–26.

9 Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA* 2012;307(14):1513–16.

10 Lin GA, Dudley RA, Redberg RF. Cardiologists' use of percutaneous coronary interventions for stable coronary artery disease. *Archives of internal medicine.* 2007;167(15):1604–09.

11 Herwig A, Weltermann B. Study protocol for a matter of heart: a qualitative study of patient factors driving overuse of cardiac catheterisation. *BMJ Open* 2017;7(9):e017629.

12 Mayring P. Qualitative Inhaltsanalyse: Grundlagen und Techniken. s.l.: Beltz Verlagsgruppe 2010.

13 Giuliano AE, Boolbol S, Degnim A, et al. Society of Surgical Oncology: position statement on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. *Ann Surg Oncol* 2007;14(9):2425–27.

14 Ager B, Butow P, Jansen J, et al. Contralateral prophylactic mastectomy (CPM): A systematic review of patient reported factors and psychological predictors influencing choice and satisfaction. *Breast* 2016;28:107–20.

15 Greener JR, Bass SB, Lepore SJ. Contralateral prophylactic mastectomy: A qualitative approach to exploring the decision making process. *J Psychosoc Oncol* 2018;36(2):145–58.

16 Flachskampf FA, Erffa J von, Seligmann C. Reimbursement and the practice of cardiology. *J Am Coll Cardiol* 2012;59(17):1561–65.

17 van Schaik TM, Jørstad HT, Twickler TB, et al. Cardiovascular disease risk and secondary prevention of cardiovascular disease among patients with low health literacy. *Neth Heart J* 2017;25(7-8):446–54.

18 Stiggelbout AM, van der Weijden T, Wit MPT de, et al. Shared decision making: really putting patients at the centre of healthcare. *BMJ* 2012;344:e256.

19 Coulter A. Shared decision-making: the debate continues. *Health Expect* 2005;8(2):95–96.

20 Elwyn G, Laitner S, Coulter A, et al. Implementing shared decision making in the NHS. *BMJ* 2010;341:c5146.

21 Barry MJ, Edgman-Levitan S. Shared decision making--pinnacle of patient-centered care. *N Engl J Med* 2012;366(9):780–81.

| Code | Comment |
|---|---|
| **1_physician-patient relationship** | Aspects of a relationship between the patient and the physician are discussed. |
| **11_trust in physicians** | The patient relies on the physicians' competency. |
| **12_distrust in physicians** | The patient does not rely on the physicians' competency. |
| **13_relationship with primary care physician** | The patient describes the relationship with her/his primary care physician. |
| **2_cardiac catheterization intervention** | General aspects regarding cardiac catheterization (on patients). |
| **21_indication for cardiac catheterization** | Reason(s) why the patient underwent cardiac catheterization(s). |
| **22_cardiac catheterization procedure** | Aspects regarding the cardiac catheterization procedure on the patient, including complications, side effects and patient's perception. |
| **221_ cardiac catheterization routine for patients** | The patient stopped perceiving cardiac catheterization as a special event, it has become a routine. |
| **222_cardiac catheterization routine for physicians** | The physician gave the feeling that cardiac catheterization is a routine treatment. |
| **23_overuse of cardiac catheterization** | The patient's descriptions suggest an overuse of cardiac catheterization. For example, regarding the intervention, the frequency, and the time between two interventions. |
| **3_patient characteristics** | Statements allowing conclusions concerning patient characteristics and potential patient types. |
| **31_patient's health literacy** | Aspects that describe the patient's medical knowledge; knowledge of laymen. |
| **312_patient's illness perception** | The patient's perception and expectations of the illness and the appraisal of consequences of their treatment. |
| **313_patient's self-diagnosis** | The patient explains her/his symptoms by her-/himself without consulting a physician. |
| **314_patient's self-care** | The patient treats her/his symptoms by her-/himself without consulting a physician. |
| **32_ symptoms** | The patient describes symptoms he/she relates to her/his heart disease. |
| **33_ risk awareness** | The patient estimates the risk associated with cardiac catheterization. |
| **34_patient's feelings** | Emotions that the patient explicitly verbalizes or shows. |

| | |
|---|---|
| **341_fear** | The patient expresses fear of the treatment, a new cardiac event, further surgery, or death. |
| **342_uncertainty** | The patient is uncertain about her/his treatment or the medical advice received; she/he is unable to appraise whether the treatment decision is correct. |
| **343_ emotional neutrality** | The patient describes her/his treatment and overall situation in a rather neutral and unemotional manner. |
| **344_resignation** | The patient gave up worrying or caring about his/her disease or future cardiac events and acts indifferently. |
| **345_scepticism** | The patient expresses doubts concerning the type of treatment. |
| **35_negative events** | The patient experienced negative events related to her/his heart disease and the treatment thereof. |
| **351_negative events regarding cardiac catheterization** | Negative incidents that occurred during the cardiac catheterization, including complications/side-effects and follow-up treatment. |
| **352_negative events in the social network** | Negative incidents related to a cardiac catheterization or heart disease in the social network, e.g. family history of heart disease, death of a relative due to myocardial infarction, or death of a friend during cardiac catheterization. |
| **353_negative events regarding other patients** | Negative incidents during or related to cardiac catheterization or the heart disease of other patients, e.g. death of a roommate during cardiac catheterization. |
| **354_negative events regarding physicians** | Negative incidents related to cardiac catheterization or the heart disease that were caused by a physician. |
| **355_negative events regarding hospitals** | Negative incidents related to cardiac catheterization or the heart disease that were caused by the hospital staff. |
| **36_patient's coping strategy** | Patient's attempt to process negative events, fears and uncertainties related to the cardiac catheterization or the heart disease. |
| **361_delegation of responsibilities** | The patient delegates responsibilities to physicians and other experts by not wanting to know anything about the disease or letting others (e.g. physicians or relatives) decide instead. |
| **362_lifestyle modification** | The patient changes her/his lifestyles actively to improve her/his prognosis and prevent further cardiac events. |
| **363_ignoring symptoms** | The patient perceives symptoms associated with heart disease, but deliberately ignores them and fails to act adequately, does not listen to her/his body, downplays the symptoms of her/his disease, ignores medical advice, e.g. for a change in lifestyle (continues drinking/smoking). |

| | |
|---|---|
| **364_belief in destiny** | The patient says that she/he was lucky or talks about destiny or a higher power that saved her/his life. |
| **37_family circumstances** | Relationship with the patient’s family: the family supports the patient or lets the patient down. |
| **38_Compliance** | The patient works together with the physician, follows advice. |
| **39_Non-compliance** | The patient does not work together with the physician, does not follow advice. |
| **4_information and patient education** | The patient describes situations of information acquisition and patient education regarding her/his heart disease and/or the cardiac catheterization. |
| **41_sources of information** | The patient describes different sources of information. |
| **411_soi physician** | The patient describes a physician as a source of information. |
| **412_soi social network** | The patient describes her/his social network as a source of information. |
| **413_soi other patients** | The patient describes other patients as a source of information. |
| **414_soi pharmacy** | The patient describes the pharmacy as a source of information. |
| **415_soi television program** | The patient describes television programs as a source of information. |
| **416_soi internet** | The patient describes the internet as a source of information. |
| **417_soi medical literature** | The patient describes medical literature such as books or journal articles as a source of information. |
| **418_soi magazines from pharmacy** | The patient describes magazines from pharmacies as a source of information. |
| **419_soi health insurance** | The patient describes his health insurance company as a source of information. |
| **420_soi rehab** | The patient describes rehab as a source of information. |
| **421_soi physician’s report** | The patient describes the physician’s report as a source of information. |
| **422_soi age/common sense** | The patient describes his age or wisdom as a source of information. |
| **43_exchange/contact person within social network** | The patient has a contact person within her/his social network with whom she/he can share her/his thoughts related to her/his heart disease. |

| | |
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| **44_insufficient patient education** | The patient lacks information about her/his disease or the cardiac catheterization or would have liked to be given more information about certain topics. |
| **45_physician information** | The patient describes what she/he understood and remembers regarding the information provided by the physician on the heart disease or the necessity of the cardiac catheterization. |
| **5_financial aspects** | The patient describes financial aspects regarding the treatment received. |
| **6_processuality** | The patient now judges her/his treatment and disease differently than at the onset of the disease (or even earlier). |
| **7_organization in hospital/practice/rehab** | The patient describes organizational aspects regarding the treatment of the heart disease in hospitals, practices or rehab. |
| | *Appendix 1: Code Book* |

| Patient ID | Gender | Age at time of interview (years) |
|---|---|---|
| **patient_1** | male | 83 |
| **patient_2** | male | 86 |
| **patient_3** | male | 53 |
| **patient_4** | female | 68 |
| **patient_6** | male | 86 |
| **patient_7** | female | 71 |
| **patient_8** | male | 75 |
| **patient_9** | female | 66 |
| **patient_11** | male | 72 |
| **patient_14** | female | 85 |
| **patient_22** | male | 56 |
| **patient_23** | male | 55 |

*Appendix 2: Patient information*

# Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Patient factors driving overuse of cardiac catheterization: A qualitative study
Anna Herwig, Dorothea Dehnen, Birgitta Weltermann

| **No. Item** | **Guide questions/description** | **Reported on Page #** |
|---|---|---|
| **Domain 1: Research team and reflexivity** | | |
| *Personal Characteristics* | | |
| 1. Interviewer/facilitator | Which author/s conducted the interview or focus group? | 5 (Methods) |
| 2. Credentials | What were the researcher's credentials? E.g. PhD, MD | 1 |
| 3. Occupation | What was their occupation at the time of the study? | 1, 5 Methods |
| 4. Gender | Was the researcher male or female? | 5 (Methods) |
| 5. Experience and training | What experience or training did the researcher have? | Methods |
| *Relationship with participants* | | |
| 6. Relationship established | Was a relationship established prior to study commencement? | 5 (Methods) |
| 7. Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | 5 (Methods) |
| 8. Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | 5 (Methods) |
| **Domain 2: study design** | | |
| *Theoretical framework* | | |
| 9. Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | 5 (Methods) |
| *Participant selection* | | |
| 10. Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | 5 (Methods) |
| 11. Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | 5 (Methods) |
| 12. Sample size | How many participants were in the study? | 6 (Results) |
| 13. Non-participation | How many people refused to participate or dropped out? Reasons? | 5 (Methods) |
| *Setting* | | |

| | | |
|---|---|---|
| 14. Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | 5 (Methods) |
| 15. Presence of non-participants | Was anyone else present besides the participants and researchers? | 5 (Methods) |
| 16. Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | 5 (Methods), 6 (Results), Appendix 2 |
| *Data collection* | | |
| 17. Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | 5 (Methods) |
| 18. Repeat interviews | Were repeat interviews carried out? If yes, how many? | 5 (Methods) |
| 19. Audio/visual recording | Did the research use audio or visual recording to collect the data? | 5 (Methods) |
| 20. Field notes | Were field notes made during and/or after the interview or focus group? | N/A |
| 21. Duration | What was the duration of the interviews or focus group? | 6 (Results) |
| 22. Data saturation | Was data saturation discussed? | 5 (Methods) |
| 23. Transcripts returned | Were transcripts returned to participants for comment and/or correction? | 5 (Methods) |
| **Domain 3: analysis and findings** | | |
| *Data analysis* | | |
| 24. Number of data coders | How many data coders coded the data? | 5 (Methods) |
| 25. Description of the coding tree | Did authors provide a description of the coding tree? | Appendix 1 |
| 26. Derivation of themes | Were themes identified in advance or derived from the data? | 5 (Methods), 6pp. (Results), Appendix 1 |
| 27. Software | What software, if applicable, was used to manage the data? | Atlas.ti Version 7 & 8 |
| 28. Participant checking | Did participants provide feedback on the findings? | N/A |
| *Reporting* | | |
| 29. Quotations presented | Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number | 6pp. (Results) |
| 30. Data and findings consistent | Was there consistency between the data presented and the findings? | 6pp. (Results) |
| 31. Clarity of major themes | Were major themes clearly presented in the findings? | 6pp. (Results) |
| 32. Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | 11 (Discussion) |