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ORIGINAL RESEARCH

The patient experience of in-hospital telemetry monitoring: a qualitative analysis

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Aims In-hospital telemetry monitoring has been an integrated part of arrhythmia monitoring for decades. A substantial proportion of patients require arrhythmia monitoring during stays in non-intensive care units. However, studies exploring patients' experiences of telemetry monitoring are scarce. Therefore, the aim was to explore and describe patients' experiences of in-hospital telemetry monitoring in a non-intensive care setting.

Methods and results Twenty face-to-face, semi-structured interviews were conducted. Interviews were conducted before discharge at two university hospitals in Norway. The patients were purposively sampled, resulting in a well-balanced population comprising 11 men and nine women, mean age 62 years (range 25–83). Average monitoring time was 9 days (range 3–14). Data were audio-taped, transcribed verbatim, and coded using NVivo software. Qualitative content analysis using an inductive approach was performed. Patients expressed a need for individualized information during telemetry monitoring. Their feelings of safety were related to responses from nurses from the central monitoring station when alarms from the telemetry were triggered. Despite perceived physical restrictions and psychological limitations associated with telemetry monitoring, they found monitoring to be beneficial because it facilitated the diagnosis of arrhythmia. Moreover, they expressed a need for improvements in wearable monitoring equipment. Patients expressed ambivalent feelings about discontinuing the telemetry and their readiness for discharge.

Conclusion Patients need individualized information about the results of their telemetry monitoring in order to better understand the arrhythmia management and to increase their experience of safety after discharge. The limitations patients experienced should be taken into consideration in further upgrades of telemetry monitoring equipment.

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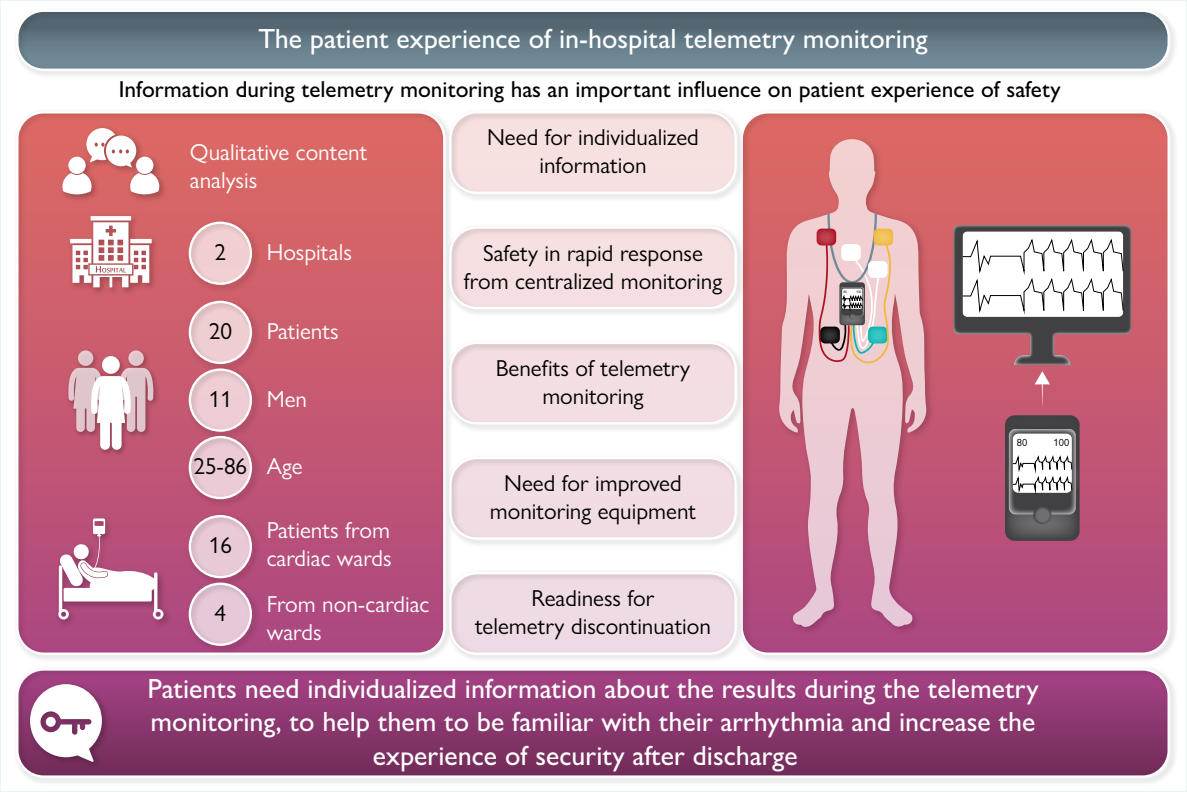
Graphical Abstract



Keywords ECG • Qualitative methods • Telemetry monitoring

Novelty

- Research on effective use of in-hospital telemetry monitoring exists; however, this is the first study to explore patients' experiences of in-hospital telemetry monitoring.
- This analysis demonstrates that patients need individualized information and education during telemetry monitoring to further enhance knowledge, confidence, and readiness for discharge.
- Even though telemetry monitoring entailed practical, physical, and psychological limitations, patients described perceived benefits of safety and a feeling of assurance of having their arrhythmia monitored and documented.
- Rapid response from the centralized monitoring station when alarms occurred was strongly related to patients' feelings of security during telemetry monitoring.

Introduction

In-hospital telemetry monitoring has been an integrated part of the hospital service for more than 60 years. It is used to monitor and diagnose arrhythmias in patients in non-intensive care wards, i.e. standard wards.[1–3] The number of in-hospital monitored patients is constantly increasing.[2,4] The telemetry system consists of a wearable telemetry unit and a central monitoring station that receives and displays signals from the units. Patients who are monitored wear a monitor transmitter with wires and three to six electrode patches connected to their chest. Continuous electrocardiogram (ECG) signals are sent to the central monitoring station, which is staffed by nurses specialized in interpreting ECG rhythms.[5,6] Hospitals often have a monitoring system whereby patients and the central monitoring station are located in separate wards.[7]

Despite extensive research on practice standards and effective use of in-hospital telemetry monitoring,[2,8–10] there has been little focus on patients' perspective of being monitored during hospital stays. In an editorial comment in *JAMA Intern Med*, Bansal *et al.*[11] specifically call for exactly these types of studies. They highlighted patients' experiences as an important reason for judicious use of telemetry monitoring. One small-scale study explored on patients' experiences of home

Table 1 Socio-demographic and clinical characteristics of patients in telemetry monitoring ($N = 20$)

Characteristics	*n* (%)
Sex	
Men	11 (55)
Age (years) mean (SD)	62 (14)
20–29 years	1 (5)
30–39 years	0 (0)
40–49 years	1 (5)
50–59 years	4 (20)
60–69 years	8 (40)
70–79 years	4 (20)
80–89 years	2 (10)
>90 years	0 (0)
Monitoring time (days) (SD)	5 (4)
3 days	6 (30)
4–6 days	5 (25)
7–14 days	8 (40)
>14 days	1 (5)
Cardiac ward hospitalization	16 (80)
Indication for telemetry	
Primary arrhythmia	9 (45)
ST-elevation myocardial infarction	2 (10)
Syncope	2 (10)
Acute heart failure	1 (5)
Grown-up congenital heart disease	1 (5)
Heart transplant	1 (5)
Transcatheter aortic valve implantation	1 (5)
Non-cardiac causes	3 (15)
Arrhythmia experienced	15 (75)
Sleep problems due to telemetry monitoring	5 (25)

ECG monitoring.[12] In this study, the investigators found that the ECG monitor and the wires resting on the patient's chest could restrict patient mobility and interfere with their ability to maintain personal hygiene. In a clinical case presentation, Chen and Zakaria[13] suggested that in-hospital monitoring may result in sleep disturbance due to hospital staff wakening patients for false alarms or to reapply detached leads. However, empirical evidence of patients' experiences of limitations and benefits of in-hospital telemetry monitoring is scarce. Therefore, the aim of this study was to explore and describe adult patients' experiences of in-hospital monitoring in non-intensive care settings.

Methods

Design and setting

Findings are reported in line with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist.[14] An inductive, explorative, and descriptive design was used to identify experiences described by patients in a real-life context.[15] The study was conducted at two university hospitals in Norway. Both sites had 36 telemetry units available for adult patients located in medical and surgical wards, who were monitored from a central monitoring station in medical intensive care units (ICU). Both central monitoring stations with 24/7 monitoring were staffed by specialized nurses or trained medical students. Assessments and alarms were communicated to the wards by telephone. The hospitals used the Philips MX 40® telemetry system and Philips IntelliVue PiiC® (Koninklijke, Netherlands), which included a small patient-worn ECG unit wired to six electrode patches attached to the patient's chest. The ECG unit is worn in a protective cover around the patient's neck.

Table 2 Core questions of the semi-structured interview guide

(1) Can you describe the limitation you experienced according to the in-hospital telemetry monitoring?
(2) How do you sleep during the night with telemetry monitoring - and how does this affect your concentration and memory on daytime?
(3) What kind of emotional aspect did you experience related to the monitoring?
(4) Can you describe the thoughts and feelings regarding telemetry removal?

Patients

Twenty patients were invited to participate in the study, and all consented to participate. Inclusion criteria were as follows: monitored for 72 h or more, experienced at least one arrhythmic event during monitoring, aged 18 years or older, spoke and understood Norwegian, able to participate in interviews lasting 30–60 min, no cognitive impairment, and provided written informed consent. The patients were purposively sampled based on sex, age, diagnosis, and arrhythmia events to obtain broad variation in clinical and sociodemographic characteristics.[16] A matrix documenting the patients' sex, age, diagnosis, and arrhythmic event was used to identify which variations we needed to include to achieve a purposeful sample. To identify appropriate patients, telemetry reports were reviewed and discussed with staff at the central monitoring station. Nurses in the wards were consulted to ensure that the patients were able to participate in an interview during their hospital stay. Characteristics of included patients are presented in *Table 1*.

Data collection

Semi-structured, in-depth interviews were conducted by the first (M.S.H.) and second (N.F.) authors. Both interviewers are intensive care nurses with extensive clinical experience with patients under telemetry monitoring and trained in qualitative research methods. None of the interviewers had any responsibility for care of the patients during the inclusion and interview period. Interviews were conducted in meeting room at the university hospitals or the patient's room, depending on the patient's preferences. Only the interviewer and patient were present during the interviews. No repeat interviews were carried out. The interview guide was based on a literature review, and on the authors' extensive experience of cardiology, resulting in five main questions. To refine the questions, the first author piloted them during the first two interviews. No changes were made after this refinement. Open-ended follow-up questions were asked in order to gain a deeper understanding of areas that seemed important to each individual. The following are examples of questions and follow-up questions: 'Can you describe how you experience a day with telemetry monitoring?' and 'Can you describe any limitations you experience due to the telemetry monitoring?'. To verify that the content communicated by the interviewee was correctly understood, the content was summarized at the end of each interview (*Table 2*). In addition, field notes were taken immediately after the interview

Table 3 Examples of how quotations emerged into themes during the analysis procedure, i.e. the abstraction process

Overarching theme: Information during telemetry monitoring has an important influence on patient experience of safety.				
Meaning units	**Condensed meaning units**	**Sub-category**	**Category**	**Sub-theme**
'I know I will be wearing this all the time, but, I am waiting for more information about what they register and why I am wearing this telemetry'.	Waiting for more information about results and the reason for the monitoring	Lack of information about their heart rhythm	Missed information	Need for individualized information
'I have not had many questions. When an arrhythmia was registered by the telemetry, I recognised the symptoms, and the nurse came running.'	Have not had any questions. In the case of arrhythmia nurse has come	Experienced that the system worked well, did not need more information	Sufficient information	
'This one [the telemetry] is my safety. When there are problems with the heart at night, the nurse is there straight away'.	It is safe that nurses comes quickly in case of problems	A safety to be monitored	Safety through continuous monitoring	Safety in rapid response from centralized monitoring
'I have noticed that they have appeared quickly. I was in the dining room once; it was just like that when there was a 'click'. Oh, shit… Then I realised that now they are coming… Yes, it took 5–10 s, then they came running. I feel that I am privileged'.	Noticed quick response when he felt that something happened to his heart. Felt privileged	Reassuring with fast response when arrhythmia occurs	Timeliness of response	
'When you experience any kind of palpitations—no matter what it is—it is documented. My experiences can be documented on paper [medical records], and that is very good'.	His experiences is documented in papers (medical records)	The arrhythmia was documented	Arrhythmia documentation	Benefits of telemetry monitoring
'This weekend, maybe a couple of times, I felt a little uneasiness in my chest… I thought "now they will come". But they never came running, and then I settled into the fact that it was nothing dangerous'.	Felt symptoms of arrhythmia, and thought that 'now they might come', but they did not come, so concluded that it was not an arrhythmia	Concluded with no arrhythmia as there was no response from the central	Symptoms verification	
'And it is these wires - the ones that loosen all the time. I do not understand why they are so poorly made'.	The wires fall off all the time, do not understand why they are so poorly made	The monitor was troublesome	Dissatisfaction with monitoring equipment	Need for improved monitoring equipment
'It is so heavy that when I had walked with it around my neck, and helped myself trying to eat, I felt a headache. I really wanted a dressing gown with pockets or something to fasten it to'.	Got a headache from the telemetry due to the weight around the neck. Missed something to secure it to	Pain in neck due to the monitoring system	Physical limitations	
'It is challenging just to be in the ward all the time. I would like to go outside and get some fresh air. It is a bit challenging just to sit here. On the other hand, there is someone who is watching you all time, so then it is still okay'.	Difficult to be in the ward all the time, want fresh air. This is challenging, but at the same time okay, because someone is watching all the time	Psychologically stressful not being able to move outside, but felt safe to be monitored all the time	Restricted range of activity	

Continued

Table 3 *Continued*

Overarching theme: Information during telemetry monitoring has an important influence on patient experience of safety.				
Meaning units	**Condensed meaning units**	**Sub-category**	**Category**	**Sub-theme**
'Yes, but I have not dared to put that thought into full bloom [discharge without telemetry]. But, I see it coming and that it could be a challenge'.	Have not dared to think about discontinuing the telemetry yet, but it could be a challenge	Challenging to discontinue the telemetry	Feelings of uncertainty	Readiness for telemetry discontinuation
'I felt secure with the telemetry, and that safety is perhaps gone when the device is discontinue. But I did not think that I was going to have this for the rest of my life, you have to take that chance. And I will probably also get some advice before I leave'	It may feel unsafe to discontinue the telemetry; it has provided security, I will probably receive some education before discharge	Anticipating that they will receive information about how to deal with arrhythmias before departure	Feel arrhythmia safe	

was completed. Interviews lasting 13–38 min were audio-recorded and later transcribed verbatim.

Analysis

The data were organized using NVivo coding assistance software and analysed using qualitative content analysis.[15,17] The first author (M.S.H.) read the transcripts twice to gain an overall impression and to become familiar with the text. Meaning units were identified relating to the aim of the study and then clarified by the research team. Secondly, the meaning units were condensed and coded and, thirdly, sorted into sub-categories, constituting the manifest content. Sub-categories were organized into categories in the fourth step. Fifth, the underlying meaning of the text was constructed (i.e. the latent content), resulting in five sub-themes, which were abstracted into an overarching theme[15] (*Table 3*). The second (N.F.), fourth (B.F.), and last authors followed the entire analytical process closely. Adjustments were made to the coding and category system, and levels of interpretation and abstraction were discussed by the research team before the final steps of the analysis were performed and consensus was reached.

Ethical considerations

The study conformed to the ethical guidelines of the Declaration of Helsinki (2013)[18] and was approved by the Norwegian Regional Committee for Ethics in Medical and Health Research in Western Norway (REK 2015/561). Written, informed consent was obtained. Anonymized data were kept in locked electronic files on the university hospital's research server.

Results

Five sub-themes were identified from the analysis (*Figure 1*), from which an overarching theme emerged: *Information during telemetry monitoring has an important influence on patient experience of safety.* The five sub-themes were labelled *Need for individualized information*, *Safety in rapid response from centralized monitoring*, *Benefits of telemetry monitoring*, *Need for improved monitoring equipment*, and *Readiness for telemetry discontinuation* (*Table 3*). These sub-themes are described below.

Need for individualized information

Patients expressed a need for tailored information during monitoring. They knew they were monitored because of an arrhythmia, and that they had to wear the telemetry at all times. However, they were not informed about the duration of the monitoring and knew little about how the telemetry monitor system worked. Informing patients that dedicated nurses monitored their heart rhythms 24/7 at the central monitoring station was perceived as important.

> *I think it makes sense to say that there are separate staff who monitor your heart rhythm. That it is not the nurses who attached the telemetry unit, or the nurses with whom I interact. Then you know that they stay in place the whole time, they do not go away. You do not risk them missing it* [an arrhythmia]. (Man, 70 years old)

Patients wanted continuous updates about their heart rhythm as this made it easier to understand the purpose of the monitoring and enabled them to be more confident about managing their arrhythmia. In addition, information provided about arrhythmic events reassured the patients that arrhythmias would be detected if serious events should occur.

Some patients stated that they were adequately informed about their heart rhythm. As long as they knew that the system worked well and experienced that their heart rhythm was under control, they felt satisfied with less information.

> *I do not know who is monitoring my heart rhythm, but it does not matter as long as I know that someone is in control of it.* (Man, 81 years old)

Safety in rapid response from centralized monitoring

Prompt responses when a lead wire or electrode patch became dislodged confirmed that someone was watching 24/7. However, patients who experienced a long waiting time before a nurse came to reattach a wire expressed feelings of insecurity and had less confidence in their care.

Patients expressed a strong sense of security as a result of knowing that a nurse continuously monitored their heart rhythm, especially after an arrhythmic event. They felt safe knowing that a nurse would come immediately to assess and intervene in the event of an arrhythmia.

> *When you have had an episode where something happened to the heart that should not happen, it is a bit scary. Therefore, it is good to know that someone is paying attention to see if there is anything abnormal happening, especially when I do not notice the arrhythmia myself.* (Man, 52 years old)

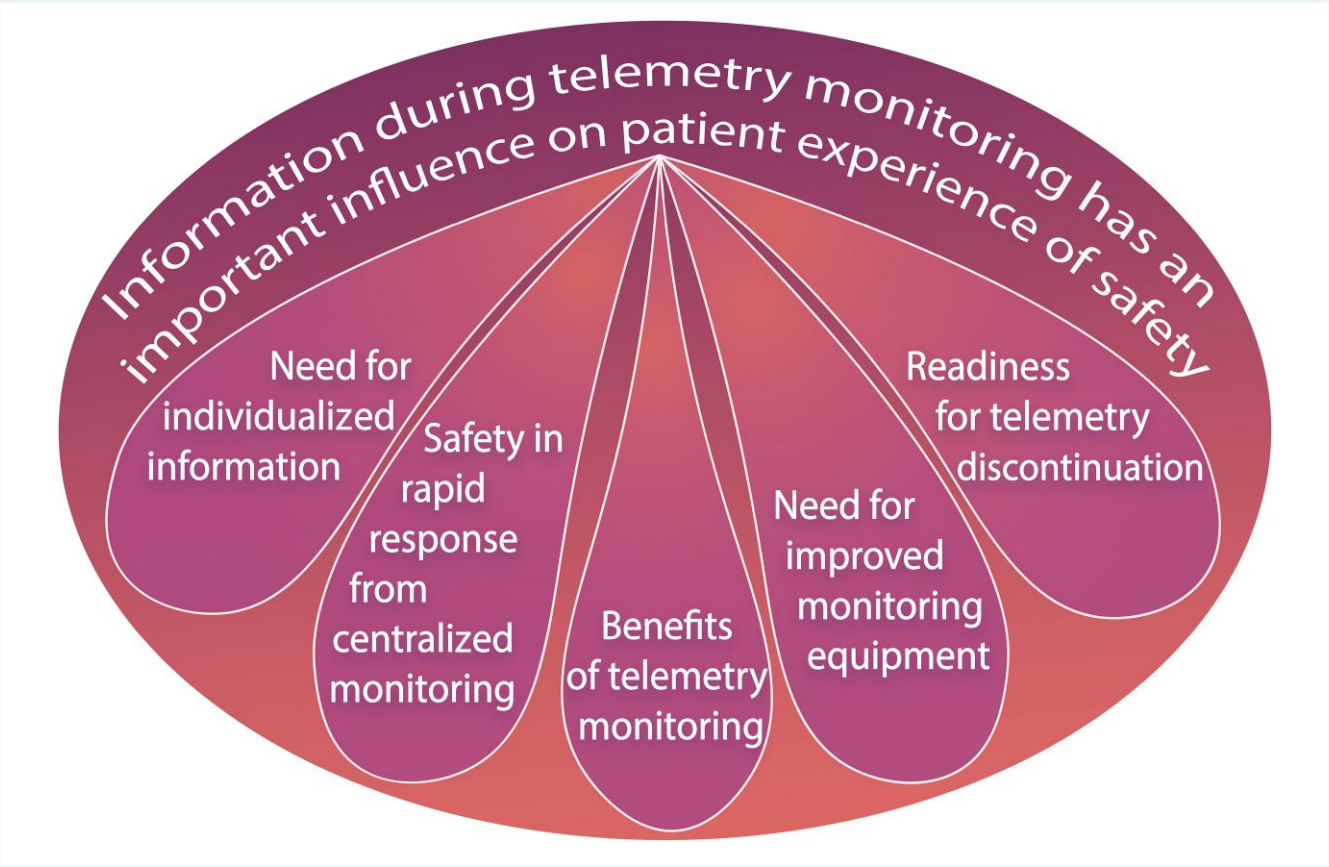


Figure 1 Overarching theme and sub-themes from the analysis.

When patients experienced that nurses responded rapidly to their alarms, they perceived the system to be working well.

> *Mostly they came straight away and attached the wires when they became dislodged, but sometimes it took a surprisingly long time. Then you get a feeling of insecurity; are they coming or not? Is anyone really paying attention to the monitoring?* (Man, 70 years)

Benefits of telemetry monitoring

Patients perceived telemetry monitoring as useful since it allowed nurses to assess and document their heart rhythm. Monitoring arrhythmias over time provided important additional data about their illness and was experienced as part of a professional medical assessment.

> *When the* [clinical] *team is going to go through all the results and all the tests I have taken, then things may happen along the way, which means that they have to change their view of the treatment. I feel that I am being looked after very professionally.* (Man, 75 years)

Patients expressed that they used feedback from the centralized monitoring as verification of whether the symptoms they perceived were related to an arrhythmia. If they experienced symptoms and no one came, they interpreted the symptoms as not being related to arrhythmias.

> *Sometimes, the nurses come to make sure that I am doing well because they observed something on the screen - even though I did not feel it. And sometimes I feel something, and think that now they will come running – but no one comes. Then I think, 'Okay, it was not that serious after all…'. There were also times when I actually felt it and they came. It is not so easy to recognise one yourself* [an arrhythmia], *so it is reassuring to have someone who pays attention to my heart rhythm.* (Woman, 25 years)

Need for improved monitoring equipment

Patients described several aspects of the telemetry monitoring equipment as problematic. The unit and the wires interfered with their activities and made it challenging to eat and maintain adequate hygiene. They had to call for a nurse every time they wanted to take a shower because the telemetry equipment could be damaged by water. Patients described being frequently disturbed by alarms, including alarms from dislodged lead wires.

> *When you have to get dressed, and when you go to the toilet, there are wires hanging everywhere, and you have to take account of both nightgowns and wires. And if you are a little unsteady and have to hold on… You only have two hands.* (Woman, 67 years old)

Patients also emphasized physical afflictions such as neck pain due to the weight of the telemetry unit, skin burns and itching from the glue on the patch, and sleeping problems related to both wires and disturbing alarms.

> *It is a bit awkward at night when you are used to lying a little on one side and a little on the other side. Because then the wires come loose quite easily. And I also lie on the electrode patches, which is not very comfortable.* (Man, 70 years)

There were patients who were not concerned, however. They woke up at night, but the telemetry did not interfere with their sleep.

The monitoring equipment prevented them from being physically active, thereby hindering early mobilization. Telemetry monitoring limited the distance patients could walk in the hospital due to the limited range of the signals from the telemetry to the central monitoring station. Patients also described uncomfortable feelings, likening the equipment they were wearing to an ankle-tracking device. They had to report to nurses every time they left the ward and experienced this as a restriction of their freedom. Patients who were hospitalized for a long time described it as stressful. The restricted range of activity also prevented patients from testing their physical capacity under safe conditions.

> *You should be physically active and not just lie in bed. I believe that it* [the telemetry] *can be an obstacle (…). You have to test what kind of physical exertion the heart is able to tolerate by walking around in the ward. Ideally, everyone should have walked a few floors up and down before discharge to be assured that this is going well.* (Woman, 50 years)

However, staying in a confined area resulted in a feeling of safety since patients knew that they were being monitored 24/7, and that they would be found quickly if a serious incident occurred.

Readiness for telemetry discontinuation

Feelings of uncertainty were expressed about discontinuation of the telemetry monitoring, especially if the patient did not feel that the arrhythmia was under control.

> *I am being transferred to the hospital hotel on Monday. But, if the heart fibrillation reoccurs, or something else that I do not notice – what happens then?* (Woman, 60 years old)

There were patients who stated that they trusted that the arrhythmia would be under control when the telemetry was discontinued. They assumed that they would get the information they needed to feel confident about their arrhythmia before discharge.

> *When it is removed* [the telemetry], *I expect the heart rhythm to have stabilised. I trust the doctors; they are the ones who have to make the decision, because at one stage or another I will be back in real life.* (Man, 82 years old)

Although they could feel anxious about discontinuing telemetry, they were prepared to take the chance. The telemetry contributed to a feeling of safety during hospitalization, but patients knew that they had to go back to their normal life without monitoring.

Discussion

To the best of our knowledge, this is the first study to explore patients' experiences of in-hospital telemetry monitoring. Patients considered individualized information during the telemetry monitoring important because it influenced their experience of safety. Their feelings of safety were also related to the nurses' responses from the centralized monitoring station when alarms were triggered. The monitoring was perceived as beneficial in terms of facilitating diagnosis of their arrhythmia, even though wearing the monitoring device entailed practical, physical, and psychological limitations. Finally, patients expressed ambivalent feelings about discontinuing the monitoring.

We found that patients were informed about the general purpose of the monitoring. This finding concurs with a National UK telemetry audit,[19] which found that verbal information was commonly given to patients. Furthermore, in a study by Pettersen *et al.*,[20] 70% reported that they were informed about the purpose of the monitoring. However, patients felt that individualized information was lacking during the monitoring. They wanted more information about how their heart rhythm had been throughout the day and requested more information about the central monitoring station being staffed by nurses specialized in interpreting ECG rhythms 24/7. They emphasized that individualized information increased their feeling of safety during monitoring.

Patients in our study highlighted rapid response times to alarms as an important factor, since it provided a feeling of safety and confirmed that someone was watching. The American Heart Association's practice standards for in-hospital telemetry monitoring[2] emphasize that the current configuration of many telemetry units, combined with the large number of false alarms, creates a noisy and disruptive work environment for the monitor watchers. This results in important alarms being ignored[2,21] and increase the response time when arrhythmia occurs.[10] Phillips and Barnsteiner[22] found 'leads off' to be the most common cause of nuisance alarms, which resulted in longer response times to alarms. Some patients in our study described a response time of up to half an hour and expressed uncertainty about whether the monitoring continued to work when leads became dislodged. Our findings highlight the need for an increased focus on electrode attachment to avoid unnecessary alarms. High frequencies of alarms may affect patients' confidence in the technology[23] and an unnecessary sense of uncertainty about whether the monitoring actually works.

One of the main benefits of telemetry monitoring is early mobilization, which improves recovery and reduces complications in cardiac patients.[3,24] However, in line with previous studies,[8,25] we found that the monitoring system may restrict mobility. Patients stated that the device was large and heavy, and the cables, patches, and electrodes were barriers to mobilization. Smaller, wireless devices improve patient comfort, mobilization, and neck discomfort due to the weight of the device. A monitoring unit designed for better patient comfort also improves hygienic aspects and reduces discomfort during sleep.[25,26] While waiting for a monitoring system that is less cumbersome for patients to wear, simple practical modifications can be introduced, such as wearing the monitor in a belt around the hips or in a dressing gown with pockets to relieve the neck of the weight of the telemetry unit. Patients in our study experienced that new and better patches led to few loose wires. It is important for the department to prioritize having the best patches available so that the patient can avoid this burden. Healthcare professionals should be aware of physical and psychological challenges due to limited mobilization. For example, action should be taken to accompany patients so that they can walk beyond the limits of the monitored area to ensure that they have resumed normal physical activity before discharge. Problems regarding restricted range of activity and mobilization can be solved if hospitals use systems with a wider monitoring range. However, in the event of an alarm, this could hinder prompt location of the patient.[24] Patients in our study stated that feeling safe because they know that they can be located quickly was more important than the limited radius of movement.

Even though patients in our study described physical and psychological limitations related to the monitoring system, they were positive about telemetry monitoring. This is an important finding, because it is in contrast to previous studies.[12,13,26] Our findings indicate that the safety and benefits of telemetry monitoring were seen as more important than the limitations the monitoring system caused. Patients in our study were keenly aware of the potentially life-threatening situations associated with serious arrhythmia.

Telemetry monitoring is mostly used in patients with serious cardiac and medical events that may be life-threatening. In a review, Chauvet-Gelinier and Bonin[27] highlighted the importance of modifying factors that trigger stress reactions among patients with heart diseases. Patients in our study perceived that only receiving information about serious events triggered uncertainty about their overall condition, which led to uncertainty about discontinuing telemetry. Updates

about their arrhythmia during the day provided reassurance and safety. Patients also stated that they received sufficient information. However, in the study by Weenk *et al.*,[25] there were patients who stated that that too much information could be stressful and lead to increased anxiety. The different needs for information that emerged from our study emphasize how important it is to focus on person-centred care and thereby improve the individualization of care for patients during in-hospital telemetry monitoring. Person-centred care helps healthcare professionals to identify and properly respond to individual needs.[28] The purpose of this approach is to incorporate the patients' perspective in the care and treatment.[29] It emphasizes the patients' views and aims to improve patients' experiences.[28] Evidence-based healthcare is based on standardized care models. However, this approach may fail to capture individualized responses to treatments. Our findings highlight patients' need for a deeper understanding of their condition and for conversations to help them process the experience of a severe arrhythmia. They expressed different needs regarding information and different experiences of the perceived limitations associated with the monitoring. Still, more studies are needed to explore patients' experience of arrhythmia. The necessity of spending time in the hospital as a learning environment for patients to more easily be able to detect their symptoms of arrhythmias is also an important factor to highlight further. If patients become more confident with their arrhythmia during in-hospital telemetry monitoring, it may decrease their feeling of uncertainty about discontinuation of the telemetry monitoring.

Methodological considerations

To evaluate trustworthiness, various aspects of credibility, dependability, and transferability are evaluated in studies using qualitative content analysis.[15]

To achieve *credibility*, we followed the steps recommended in the analysis process of Graneheim and Lundman[15] and adopted an inductive approach, allowing new codes to emerge during the analysis to gain new insight into this subject. Presenting representative quotes from the transcribed text facilitates evaluation of credibility based on the selected meaning units used in the condensation and abstraction process. It is important to consider the possibility of bias being introduced given the authors' preunderstanding of the subject. Thus, the interview guide was developed to gain insight rather than confirmation of beliefs. Purposive sampling ensured broad variation in demographic characteristics, the length of monitoring, and arrhythmia history. Data saturation was discussed among the authors. The interview process was concluded when the interviews no longer provided new information. To achieve *dependability*, open and non-directional questions were used, which enabled the patients to elaborate on the phenomena they perceived as most important. The coding frame was data-driven. The final codes, categories, and themes were decided after a discussion among the authors when content with a similar meaning was found. The authors discussed thoroughly the levels and content of the interpretations, and discrepancies in the data interpretations were discussed until consensus was reached.[15,17] This ensured that the coding and interpretation did not just represent one individual's understanding of the material. The team worked closely to ensure that the codes and categories that emerged from the original text were in line with the study aim and always in accordance with the informants' statements. The authors endeavoured to ensure transparency in the analysis process. Demographic characteristics, including age, sex, length of monitoring, and arrhythmia history, were included to ensure the transparency needed to judge transferability. Patients were recruited from two university hospitals in Norway to strengthen transferability, although transferability beyond the local aspect of the study area may be somewhat limited. However, this potential limitation may be tempered since the telemetry systems are similar in the Nordic countries. In addition, practical problems experienced by patients related to the telemetry system are transferrable to other healthcare systems in other countries irrespective of monitoring system used. However, smaller hospitals do not always have a dedicated monitor watcher to staff the central monitoring station 24/7. This can lead to longer response times to alarms, which may affect the patient's experiences of safety during in-hospital telemetry monitoring.

Conclusions

Our study provides a deeper understanding of patients' experiences of telemetry monitoring. Patients were generally positive about their telemetry monitoring experience, describing perceived benefits of safety, rapid responses by central monitoring nurses, and a feeling of assurance because their arrhythmia was monitored and documented. However, there is a need for individualized patient information and education during telemetry monitoring to further enhance knowledge, confidence, and readiness for discharge. Finally, patients described dissatisfaction with existing telemetry monitoring equipment. These findings show a need for modifications by monitoring device companies, which could collaborate with hospitals about how to improve cardiac monitoring for hospitalized patients.

Author contributions

M.S.H.: writing—original draft, formal analysis, and data collection. N.F.: conceptualization, supervision, methodology, project administration, writing—review and editing, formal analysis, and data collection. B.B.: supervision and writing—review and editing. B.F.: methodology, formal analysis, and writing—review and editing. J.L.: writing—review and editing. T.R.P.: supervision and writing—review and editing. K.E.S.: writing—review and editing. T.M.N.: conceptualization, project administration, supervision, methodology, formal analysis, and writing—review and editing.

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Data availability

No additional data available.

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