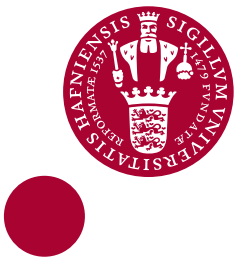

Unpacking telemonitoring work

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Unpacking telemonitoring work: Workload and telephone calls to patients in implanted cardiac device care

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ABSTRACT

Objective: Telemonitoring of cardiac implantable electronic devices (CIEDs) has many advantages. However, telemonitoring involves clinical work that is often overlooked or considered a burden, such as the work performed during telephone contact with patients. The objective of this study was to scrutinize telephone calls to and from patients to understand the clinical workload in CIED remote monitoring. The focus was on *time spent*, *type of work*, and the *content* of telephone contact with patients.

Methods: A combined quantitative and qualitative observational study was conducted at a large CIED remote monitoring center. The unit 'encounter' was used to describe either a telephone call between patient and clinician and/or a complete review of a CIED data transmission. The time spent on different encounters was measured, the telephone call content was identified and described, and the different types of clinical work were described.

Results: A total of 260 encounters were analyzed. Encounters that involved patient telephone contact were more time consuming. Telephone calls were mostly about the home monitoring box, CIED transmission data, and symptoms. In most telephone calls, two or more topics appeared. Five types of clinical work were performed: inclusion work, coordination work, diagnostic work, education work, and comfort work. Inclusion work and diagnostic work were the dominant types.

Discussion: Patient telephone contact in CIED telemonitoring is typically described as a "burden". This study unpacks the contents and functions of telephone calls between patients and clinicians and suggests that the function of telephone contact should be recognized as integral, rather than burdensome, to the clinical work in CIED telemonitoring.

1. Introduction

Telecare work is increasingly becoming part of clinical work. Telemonitoring of cardiac implantable electronic devices (CIEDs) such as pacemakers, ICDs and loop recorders, was first piloted in 2001 [1] and is now standard of care [2]. There are many advantages of telemonitoring, also known as CIED remote monitoring: increased survival [3], faster detection of clinical events [4], reduced hospitalization, and fewer ambulatory visits [5,6]. Some aspects of patient acceptance are also improved since patients no longer need to travel to the clinic [7].

However, studies also show that CIED remote monitoring introduces disadvantages for both patients and clinicians. The burden on the clinical workload increases as a result of, for example, more administrative work for nurses and an increased need for patient telephone contact to resolve technical issues related to the use of the home monitoring system [8]. Contacting patients through telephone calls has substantial implications for the clinical workflow [9], and patient education and coordination have become challenges that affect both patients and clinicians [7,9]. For patients, the decreased communication with the clinic can also create uncertainty and anxiety [10]. This has led to patients wanting more detailed feedback from remote follow-ups [11]. Similar issues were found in other telecare studies. Here, the challenges are described as the requirement of "new responsibilities" and "new competencies". For clinicians, telecare involves difficulties with establishing proximity at a distance and for patients it involves uncertainty about using, for example, a home monitoring system

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[12,13]. Attention to the consequences of new technologies and a detailed description of the invisible work is important to fully understand both the advantages and disadvantages of telemedicine, and to identify opportunities for improvement [12,14–16].

While other studies have focused on the diagnostic work of interpreting CIED transmissions [1–9], this study examined the understudied telephone contact to and from patients and the related clinical workload in CIED remote monitoring through a time and activity study.

2. Method

2.1. Setting

The CIED clinic at the Rigshospital, University of Copenhagen, Denmark is one of the largest remote monitoring centers in Europe. In 2017, the clinic followed 3,396 patients with a broad range of CIEDs, including ICDs, CRT-Ds, CRT-Ps, pacemakers, and implantable loop recorders from all major manufacturers: 1,298 patients on CareLink™ Network (Medtronic), 1,662 patients on Merlin@home™ (Abbot, previously St. Jude Medical), 272 patients on LATITUDE™ Home Monitoring System (Boston Scientific), and 164 patients on Home Monitoring® (BIOTRONIK). All four types of remote monitoring systems consist of a home monitoring box that can transmit CIED device data wirelessly from a patient's home to a clinical web application. The daily staff consisted of seven full time and two part-time device technicians (a mix of nurses and bio analysts), a physician (cardiac electrophysiologist), and a secretary.

The CIED clinic is divided into three sections: Outpatient section, Acute section, and Remote Section. The Outpatient section is where the in-person scheduled device follow-ups are conducted with an average of 92 patients/week (15–20 minutes/contact). The Acute section is where acute and other non-scheduled telephone calls are handled (approximately 75/week) as well as in-person follow-ups with an average of 35 patients/week. The Remote section is where the incoming CIED transmissions from the home monitoring systems are reviewed and where non-acute telephone calls are handled.

2.2. Study focus

This study focused on describing and analyzing time consumption and activity in the Remote section of the CIED Clinic. On a typical day, remote follow-ups and telephone calls are handled by 2 to 4 device technicians and a physician on call. Working hours are Monday-Friday 8:00 a.m. to 3:00 p.m. and telephone opening hours for non-acute patient calls are 9:00 to 11:00 a.m. Around 15 patient phone calls are received during telephone opening hours. The total number of CIED remote transmissions in 2017 was 17,395, which is an average of 69 transmissions per workday, where 5.6% (968 transmissions) required a physician's assessment. Around 10 to 15 transmissions per week are 'missed' due to patients' home monitoring box being deactivated or unable to connect wirelessly to the patient's CIED.

2.2.1. Observation unit: 'encounter'

To capture the relation between time consumption, activity, and the need to communicate with patients, the unit 'encounter' was used to describe a beginning and end-time of either a patient-to-clinician telephone call or a complete review of a transmission with or without a telephone call. The latter is typically called a remote follow-up [17].

The transmissions and telephone calls were divided into six types of encounters with two overarching categories: *encounters without a telephone call* (transmissions with no events, with events, and missed transmissions), and *encounters with a telephone call* (with potentially severe events, missed transmissions and non-acute telephone calls from patient to clinician).

2.3. Data collection and analysis

A combined quantitative and qualitative observational study design was applied. Data collection was carried out by three university researchers (the first three authors) conducting participant observation of remote follow-ups and telephone calls in the Remote section of the CIED clinic in time slots of 8 a.m. to noon, noon to 3 p.m., or the whole work day. Observations were carried out over 38 days and all observations were time and audio recorded as well as annotated with descriptions of activity and contents of telephone calls to and from patients. The tools included spreadsheets and time, notes, and audio recording software. The study was approved by The Danish Data Protection Agency. Ethical concerns and issues of patient privacy were dealt with by only recording and analyzing anonymous data including time, activity, and telephone call content. The researchers conducting the study only had access to the clinician side of the telephone conversations and therefore did not receive nor record any patient identifiable data. All clinicians who were observed in the study gave informed consent.

Data collection and data analysis were carried out iteratively in three overall cycles with an abductive approach aimed at constructing grounded theory [18]. Based on observational data, categories were developed from cooperative reasoning and were iteratively connected back to practice until no new categories emerged in observations. To strengthen the analytical conjecture, theoretical concepts of medical and telecare work were used in the analysis. In the first cycle, observations were conducted along with time and note taking. Open-ended coding and initial categories (telephone call content and types of activities) were developed in joint analysis workshops. In the second cycle, initial categories were tested, and a second round of coding and category development took place including reviews by device technicians to ensure association with practice. The third cycle ended the data collection and data analysis with a review of all encounters using the complete set of categories. Analysis of the types of work involved drew on concepts from social science studies of healthcare and the interdisciplinary field of Computer-Supported Cooperative Work (CSCW).

3. Results

The CIED remote monitoring practices are described in three parts. First, an overview of time spent on different types of encounters is provided. Second, the contents of telephone calls with patients was undfolded through a description of typical topics, and their frequency and overlaps within encounters. Third, the kinds of work performed are unfolded by connecting the immediate findings with theoretical concepts from the literature on medical and telecare work.

3.1. Time spent on different types of encounters

A total of 260 encounters were observed and analyzed in this study. The overview of time spent is presented in Table 1. The average time for handling transmissions with no events was 3.08 ± 0.30 min. The activity was carried out by a device technician alone and consisted of reviewing device data presented on five to ten webpages in the remote monitoring web application. Transmissions with events but without telephone calls took, on average, 5.27 ± 1.38 min. Some events were not clinically actionable and therefore did not require patient contact. A few more resources were typically needed to decide about contacting the patient, such as information from the electronic medical record as well as consulting another device technician or physician. Handling missed transmissions that did not require a telephone call took 4.57 ± 1.47 min, and was typically resolved by looking up the date for the next in-clinic follow-up and by notifying the patient electronically through a digital mailbox or an SMS text message. The average handling time for non-acute telephone calls from patients was 7.25 ± 1.29 min. Handling transmissions with events and telephone

Table 1
Time spent on encounters in CIED remote monitoring.

Total handling time of encounters (time in minutes)						*Telephone call duration (time in minutes)*			
Encounter type	*n*	*Avg.*	*Median*	*Range (min / max)*	*95% Conf. interval*	*Avg.*	*Median*	*Range (Min / Max)*	*95% Conf. interval*
No events	52	3:08	2:46	0:39 / 6:55	[2:37; 3:38]				
Events	50	5:27	2:55	0:45 / 29:57	[3:49; 7:05]				
Missed	18	4:57	3:11	01:34 / 14:14	[3:10; 6:43]				
Events + *telephone call to patient*	19	20:07	17:55	2:29 / 1.10:10	[11:56; 28:17]	5:26	5:39	1:16 / 13:06	[1:58; 7:00]
Missed + *telephone call to patient*	11	7:25	5:36	2:16 / 25:47	[3:28; 11:22]	1:47	1:07	0:18 / 7:04	[0:38; 2:56]
Telephone call patient to clinic	109	6:56	4:24	0:39 / 38:59	[5:45; 8:07]	5:15	3:41	0:39 / 26:00	[4:27; 09:42]
Total	260								

call took an average of 20.07 ± 8.10 min. For missed transmissions where a telephone call was needed to resolve the issue, the average handling time was 7.25 ± 3.58 min.

3.2. Topics in encounters with patient contact

While remote monitoring ideally minimizes the need for contact between home and clinic, telephone calls played a key role in three kinds of observed encounters (Table 1). To understand how, the topics raised in the telephone calls are first described.

3.2.1. Examples and frequency of topics in telephone calls

Eight recurrent topics in telephone calls were identified: Home monitoring box, transmission data, symptoms, appointments, implanted cardiac device, behavioral advice, medication, and other. In Table 2, each topic is illustrated with quotes to exemplify the meaning of the topic category.

In telephone calls from patients to clinicians, the most frequent topics were the *home monitoring box* (in 63% of the calls), followed by *transmission data* (40%), *symptoms* (21%), and *appointments* (21%) (Table 3). Overall, this was in line with the purposes of the daily telephone hours, namely that patients could call in with questions regarding home monitoring, symptom experiences related to making a transmission, or appointments. Telephone calls about the home monitoring box would, for instance, involve arranging the replacement of a dysfunctional box or making a note about a break from sending transmissions due to the patient going on vacation. In the case of transmission data being the main topic, handling a telephone call would typically involve consulting the physician for further interpretation, or planning an extra visit for reprogramming, or scheduling device replacement. Importantly, other topics also occurred with relatively low frequency in calls from patients to clinicians, such as questions regarding the implanted cardiac device (14%) and behavioral advice (9%), indicating that device technicians, who handled the incoming telephone calls, did more than ensure the production and initial processing of transmission data.

In telephone calls from clinicians to patients, the most frequent topics were transmission data (84%), symptoms (53%), appointments (32%) and medication (26%) (Table 3). In a typical situation, the telephone call was sparked by the need for information about the patient's symptoms in relation to a transmission revealing a clinical and/or CIED-related event. Further action was then needed, for instance, to make an appointment to reprogram the device, to initiate medication adjustment in cooperation with the general practitioner or a physician at another hospital, or to refer the patient for further investigations and/or surgical procedures.

3.2.2. Multiple topics in telephone calls

As demonstrated by the examples above, multiple topics could appear in one telephone call. Some topics were naturally linked and often occurred together, like transmission data and symptoms or home monitoring box and appointments. Other combinations were more surprising, such as when a telephone call from patient to clinician about a malfunctioning home monitoring box evolved into a dialogue about recently experienced symptoms and behavioral advices. More than half of telephone calls from patients to clinicians involved more than one topic (58%) (Table 4). In the majority of telephone calls from clinicians to patients following an event (78%), more than one topic appeared. These types of telephone calls also, on average, took more time, indicating a higher complexity of problem solving (Table 1). Only a minority of calls following a missed transmission (27%) involved more than one topic.

Table 2
What are the telephone calls between clinicians and patients about? Example quotes to illustrate the topics.

Topic	Quote
Home monitoring box	*"Yes, press the button only one time, and it's going to work."* *"It's not uncommon for it to take a bit of time the first time it sends."*
Transmission data	*"In three of the transmissions you have extra heartbeats. (…) It is very regular. It looks like the heartbeats come from the atria. So, it's totally harmless."* *"You have an episode with extra heartbeats, is it something you have noticed?"*
Symptoms	*"Did you notice something on the 9th at 8.50 pm - it seems like you have been exercising?"* *"If you tell me, 'I experience this 20 times a day, every day'. Then I know that it's right. I can see it's crazy here."*
Appointments	*"What about February 23? It's a Tuesday - yes at 11.30"* *"I can see you have agreed to come here next week. I checked the system - was it not March 2nd?"*
Implanted cardiac device	*"It's supposed to help your heart keep the pace all the time but this time it does not work because it cannot change this kind of heartbeats"* *"It's because the last lead you had implanted is on the outside of your heart and close to a nerve, so when it works, it can affect the nerve so that you can feel it all the way up in your throat. (…) Yes, but do not lie on the left side, because the nerve will come too close to the wire"*
Behavioral advice	*"On the days where there've been these electrical problems – it's very important that he writes it down so that we can check if anything at all happened on those days."* *"Then, we are able to say GO because it's okay"*
Medication	*"What medicine do you take? How much - once or twice a day?"* *"Could you tolerate it or could you tolerate a little more?"*
Other	*"Have you been ablated lately?"* *"Is it the medical record you want? You can always get a copy of your record, that's no problem."*

Table 3
What are the telephone calls between clinicians and patients about? Frequency of topics in %.

	Patient to clinician (n = 109)	Clinician to patient: Transmission with events (n = 19)	Clinician to patient: Missed transmissions (n = 11)
Home monitoring box	63 %	11 %	100 %
Transmission data	40 %	84 %	0 %
Symptoms	21 %	53 %	9 %
Behavioral advice	9 %	16 %	0 %
Implanted cardiac device	14 %	16 %	9 %
Appointments	21 %	32 %	18 %
Medication	6 %	26 %	0 %
Other	12 %	0 %	0 %

Table 4
How many topics appear in a telephone call between clinicians and patients?

	Patient to clinician (n = 109)	Clinician to patient: Transmission with events (n = 19)	Clinician to patient: Missed transmissions (n = 11)
1 topics	42 %	21 %	73 %
2 topics	34 %	21 %	18 %
3 topics	15 %	21 %	9 %
4 topics	6 %	21 %	0 %
5 topics	1 %	5 %	0%

3.3. Types of work in encounters with patient contact

The range of topics appearing in telephone calls involved different types of work. Five categories of work involved in CIED remote monitoring were identified: diagnostic work, inclusion work, coordination work, comfort work, and education work (see Table 5 for examples of each type of work). Below, the five main types of clinical work are defined and quantified.

3.3.1. Diagnostic work

Diagnostic work is the work of interpreting, determining, and scoping information as well as deciding on what action to take [19]. Diagnostic work was the most visible kind of work in observations of remote CIED patients' monitoring. It involved reviewing and interpreting the CIED transmission data to diagnose the condition of the patient's heart and/or overall health status. Other studies of remote monitoring practices typically focused on diagnostic work [1–9]. In the observed practices, diagnostic work was often conducted without telephone contact with the patient (Table 1). However, in encounters with actionable events on transmissions, the diagnostic work led to a telephone call where information from patients about symptoms and medication were used to interpret transmission data (68%) (Table 6). In telephone calls from patients, diagnostic work was also carried out, although to a lower degree (25%), typically when a patient called about having made an extra transmission.

3.3.2. Inclusion work

Inclusion work is the more technical and practical type of work that device technicians carried out. It involved supporting patients in using the home monitoring box or ensuring that transmissions came through. The concept of *inclusion work* has been used by Oudshoorn [20] to draw attention to the crucial, yet often overlooked, work performed by telecare workers of "turning patients into users" of telecare devices. In the observed remote monitoring practices, inclusion work was performed over the telephone such as instructing or trouble-shooting a patient's use of the home monitoring box. This work was dominant in telephone calls from clinicians to patients after a missed transmission (100%) as well as in calls from patients to clinicians (66%). These two kinds of calls were handled by device technicians and it is therefore tempting to describe it as technical work, as in the everyday parlance in the clinic. However, this label is too narrow. Ensuring the connection between home and clinic was not just done by purely instructing and solving technical issues (like ordering a new home monitoring box). It also involved motivating patients to further comply with the remote monitoring scheme and reassuring patients that they were operating the system correctly.

3.3.3. Coordination work

Coordination work is closely related to inclusion work as it describes the work of connecting events and actors. As a core concept in the research field of Computer-Supported Cooperative Work (CSCW) [21–24], coordination has been used to broadly describe *"a process of bringing artifacts and activities together and making them part of a larger system"* [25]. Coordination work was performed in nearly half of all telephone calls from patients to the clinic (45%), typically by requesting patients to make a transmission, updating patient contact information, or confirming or rescheduling visits. In telephone calls from clinicians to patients following an actionable event, coordination work was even more frequently performed (63%) and typically involved arranging an extra visit in the device clinic or referring to another hospital or the general practitioner for medication adjustment. Coordination work was also performed in calls from clinicians to patients following a missed transmission (27%).

3.3.4. Comfort work

Comfort work describes clinicians' work of reassuring, encouraging, and empathizing with patients' illness experiences and discomforts. Adapted from Strauss et al. [26], the concept captures a widely overlooked part of remote monitoring, namely the relief of patients' emotional distress[1]. Comfort work was frequently performed by device technicians as well as by physicians in telephone calls with patients (in 37% of clinician-to-patient calls following actionable events; 25% of patient-to-clinician telephone calls). It was typically interlinked with either diagnostic work or inclusion work: reassuring patients "that everything was fine" and that "we'll keep an eye on you".

Comfort work was part of supporting patient compliance and thereby ensuring the availability of transmission data needed for diagnostic work. For most clinicians, comfort work was an intricate part of their professional attitude; for example, the physicians would take time to explain the severity and whether or not to worry about signs and symptoms related to a cardiac event.

3.3.5. Education work

Education work covers the illness-related explanations, teaching, and instructions that clinicians offered patients during the observed telephone calls. In practice, it typically involved explaining how the

[1] Strauss et al. [26] introduced the term comfort work to describe health professionals' work of relieving physical pain by technical as well as psychological means. However, adapted to describe the observed remote monitoring practices, comfort work is here used closer to the common-sense understanding of 'comforting' (what Strauss et al. calls 'sentimental work') to capture the work of relieving emotional distress over the telephone.

Table 5
What kind of work is performed in encounters with patient telephone contact? Example quotes to illustrate the categories of work.

Category	*Quote*
Diagnostic work	*"We can see that last night, at 11 pm, you had a slightly high heart rate. I just want to hear if you felt good or if you felt worse at that time?"*
	"Have you been taking a nap, because it was around 1 o'clock? Did it happen in the middle of the day?"
	"I will check if there are any episodes. Are there any special times when it happens? For example, when you lie in a certain way?"
Inclusion work	*"You are supposed to call us."*
	"Yes, sit in front of it. Press once on the white button to wake the machine up. Then once more and then it begins to make a transmission. You just need to sit in front of it until it comes all the way down, and all the squares are filled."
	"What happens is that the home monitoring box sometimes gets updates from the outside because it's wireless. And like a normal computer, it must be restarted. It just has no way of telling us that it could not send. And we can see this here at the clinic. And then we will send you a letter. It's so nice that you've done exactly as you should and it works exactly as it should."
Coordination work	*"So, I think we should give you a new time so you can come in and we can look through it all and see if that's something we can fix."*
	"Yes, but then your own doctor should be contacted. It can also be a heart implication that has nothing to do with the rhythm."
	"I cannot transfer you to France. It's easier if the hospital in France delivers a box. If I order a new box, we have to involve the device company in the United States and it will be a mess. You may have to have a new box from us then. What I must do is order a new box"
Comfort work	*"We'll keep an eye on you."*
	"Are you alright? That's good. (…) Is there anything else you want to ask about?"
	"So, what you may feel is just that your pacemaker is working - so there's nothing to worry about at all."
Education work	*"It means your chambers fibrillate a little – it's nothing that matters, but it's to see if you need some medicine."*
	"Yes, blood pressure does not have much to do with what we have here. (…) It has nothing to do with your heartbeat. And that's what I can see. It's quite fine, it's just the way it should be. It's actually pacing as it should. So, I cannot do much more for you because what I take care of is the pacemaker. The pacemaker works and it is doing what it should."
	"When there is atrial fibrillation, the extra heartbeats can come from so many places. So, we make some scars around the lung veins where 9 out of 10 of the extra heartbeats can come from. Then, if they come from the lung veins, they cannot get to the heart. And this could indicate that this is where they came from because you did not feel it after that."

Table 6
What kind of work is performed? Frequency of topics in %.

	Patient to clinician (n = 109)	Clinician to patient: Transmission with events (n = 19)	Clinician to patient: Missed transmissions (n = 11)
Inclusion work	66 %	32 %	100 %
Diagnostic work	26 %	68 %	0 %
Coordination work	46 %	63 %	27 %
Comfort work	26 %	37 %	9 %
Education work	25 %	37 %	27 %

implanted cardiac device worked or the purpose of taking a particular type of medicine. Education work occurred in 37% of clinician-to-patient telephone calls following actionable events, in 27% of calls following a missed transmission, and in 25% of patient-to-clinician calls. It was performed by all clinical staff including device technicians and physicians. Education work bordered to, and often overlapped with, comfort work in that it may include comforting the patient by minimizing anxiety. It can, thereby, also be used to capture the clinicians' interactional work (providing explanation of the treatment and underlying heart disease) and building trust (providing insights into the reach and limits of the remote monitoring scheme). Yet, education work can also be seen as a distinct kind of work that increases patients' insights into their treatment or supports patients in their self-care activities.

To sum up, Table 6 shows that often more than one kind of work was performed in the observed telephone calls in CIED remote monitoring. Diagnostic work, inclusion work, and coordination work were the most frequently performed types of work.

4. Discussion

The objective of this study was to understand the clinical work practices in CIED remote monitoring by focusing on time spent and analyzing the topics and types of work performed in telephone contact with patients. In the following, the main findings as well as the limitations of the study are discussed.

4.1. Main findings

4.1.1. Patient contact increases time spent in remote monitoring

Handling encounters with patient telephone calls was clearly more time consuming than handling encounters that did not involve patient contact. Other studies found similar results. A time and activity study from the Cleveland Clinic shows that handling transmissions that required clinical action such as hospitalization, scheduling procedures, or device upgrade, took more time (21.0 ± 7.4 min vs. 10.1 ± 2.1 min) [9]. Similar to the present study, there was a notable broad span in how much time it took to handle actionable encounters with or without patient contact. This is because the diagnostic work varies from case to case and depends on the availability and interpretation of information, often involving peer consultation and patient communication.

4.1.2. Patient compliance requires inclusion work via telephone

Clinicians handled missed transmissions on a weekly basis and when telephone calls to patients were required, there was a broad span in the duration of time spent, yet inclusion work was always involved. However, two thirds of the incoming telephone calls from patients and one third of the calls from clinicians to patients following an actionable event also involved inclusion work. Another study evaluated the manpower and workload associated with implementation of a workflow model at 75 Italian remote CIED monitoring clinics [8]. The study found that half of the patients were contacted during remote follow-ups with a median telephone call duration of three minutes, which is similar to this study. Missed transmissions complicated the workflow efficiency leading to telephone follow-ups that consumed almost an hour per day (a mean of 21 patients/day that in total took a mean of 55.1 min/day). Thus, telephone calls of a seemingly practical and technical nature constitute a time-consuming, but also indispensable, part of remote CIED monitoring practices across different settings.

4.1.3. Telephone calls with patients serve multiple, important purposes

Telephone calls with patients are thus an integrated and important

part of CIED remote monitoring. In related studies, telephone contact is typically described as a "burden" to the clinical work in CIED remote monitoring and as extra work of ensuring compliance [8,9]. However, this study reveals that the contents and the work performed during telephone calls between patients and clinicians served many purposes, with different topics and different types of work involved.

First, all types of work performed during telephone calls can ultimately be seen as supporting the diagnostic work. That is, in the observed practices, the obvious diagnostic work of interpreting transmission data was often accompanied by several other types of work. Diagnostic work would typically *lead to* patient education and/or coordination work where the clinician needed to explain about symptoms and medication management along with making appointments in the clinic. Diagnostic work could also, for instance, be *preceded* by inclusion work as when a conversation about a patient's difficulties with using the home monitoring box became an occasion for the patient to ask about symptoms or the content of recent transmissions. Even in single-topic conversations, more types of work would be performed that ultimately *enable* the diagnostic work. For example, in a telephone call about a malfunctioning home monitoring box the device technician would instruct the patient in how to operate and secure the technical setup (inclusion work), while she also reassured the nervous patient about the reliability of the monitoring setup (comfort work) and encouraged further use.

Second, while the clinical work related to the home monitoring box and the implanted cardiac device would be described as "technical work" and, at times, regarded as tedious and too time-consuming, it also served purposes that went beyond technical matters to the core of patient care: managing patients' symptoms as well as their concerns. The involved types of work (inclusion work, comfort work, and education work) are widely *invisible* in formal as well as informal descriptions of remote monitoring. In Denmark, reimbursement is mainly associated with two types of charges, transmissions that do or do not require a physician. Telephone contact alone does not warrant extra charges. However, the types of work performed in telephone contact with patients were an important part of the observed remote monitoring practices – ultimately enabling the diagnostic work to be conducted and reflecting the range of professional skills present, and needed, in the clinic. This finding is in line with other qualitative studies of telecare work that demonstrate the crucial, yet ambiguous role of telecare workers in making the telecare system work, through technical support, but perhaps even more importantly, by providing patient-centric care [12,27].

A general conclusion to draw from this is that telephone calls enable the responsive provision of device treatment as well as patient care in a broader sense. Thus, the function of telephone calls should be recognized as integral to, rather than a burden on, the clinical work practices in remote CIED monitoring setup as the one described here.

4.2. Limitations

This study is a single center study and the findings related to the topics and work performed during telephone contact with patients in remote CIED monitoring may be specific to the local organizational context and the reimbursement model. Measures of time spent in related studies and mentions of telephone contact, indicates that the main parts of the findings are generalizable. It is a limitation that the study design merged encounters handled by different clinicians, who clearly had different working styles. No distinctions were made between a) work performed on which weekdays and/or in different seasons, b) changes in the physical space of where the work took place in the clinic, c) the manufacturer and the corresponding remote monitoring website, the type of CIED, or the type of transmission (i.e., scheduled, patient-initiated, device-initiated), or the type of event e.g., AT/AF, VT/VF, lead or device problems, and antitachycardia therapies). These are all variations that deserve closer attention in further studies of CIED remote monitoring. Finally, it is a limitation to the depth of the study that it only focuses on the clinical side. The work that patients perform in remote monitoring, and in particular before and during telephone calls, remains to be explored in order to fully understand remote monitoring practices.

5. Conclusion

Telemonitoring of cardiac implantable electronic devices (CIED) has many advantages but introduces the need for patient contact over the telephone. Telephone calls increase the time spent and are often described as a "burden" on the clinical workload. This study shows that telephone calls have a necessary function and support five types of clinical work in CIED remote monitoring: inclusion work, diagnostic work, comfort work, education work, and coordination work. Telephone calls typically involve more than two topics, support clinical decision-making, and enable the provision of patient-centric care. Future studies and innovation of telemonitoring systems need to consider ways to improve support for all types of work in order to make patient-to-clinician communication more effective and efficient.

Summary points

- In telemonitoring of cardiac implantable electronic devices (CIEDs), telephone calls between patients and clinicians increase time spent.
- Telephone calls are often described as a "burden" to the clinical work.
- This study shows that telephone calls have a necessary function in telemonitoring for both patients and clinicians: They support clinical decision-making and enable the provision of patient-centric care.
- Patient telephone contact supports different types of clinical work and typically involves conversations about several important topics.
- Future studies and development of telemonitoring systems need to consider ways to improve support for patient communication.

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