Title: Remote patient telemonitoring for heart failure care. Experiences and perceptions of nurses and physicians in a cross-sectional study from the Nordic Baltic Region.

Authors: Ina Thon Aamodt, Edita Lycholip, Jelena Celutkiene, Anna Strömberg, Dan Atar, Ragnhild Sørum Falk, Thomas von Lueder, Ragnhild Hellesø, Tiny Jaarsma, Irene Lie

Corresponding author: Irene Lie, Centre for patient centered heart- and lung research, Department of Cardiothoracic surgery, Building 63, Box 4956 Nydalen, Oslo University Hospital Ullevål, 0424 Oslo, Norway.

Mobile Phone: +47-99026729, E-mail: Irene.lie@ous-hf.no

Affiliations

Ina Thon Aamodt RN, MNSc
Centre for patient centered heart- and lung research, Department of Cardiothoracic surgery, Oslo University Hospital Ullevål, Oslo, Norway; Faculty of Medicine, Institute of Health and Society, Department of Nursing Science, C, Norway.
Email: inamarieaamodt@gmail.com

Edita Lycholip RN, MNSc
Clinic of Cardiac and Vascular Diseases, Institute of Clinical Medicine of the Faculty of Medicine of Vilnius University, Vilnius, Lithuania; Clinic of Cardiac and Vascular Diseases, Centre of Cardiology and Angiology, Vilnius University Santaros Clinics, Vilnius, Lithuania.
Email: Edita.Lycholip@santa.lt

Jelena Celutkiene MD, PhD
Clinic of Cardiac and Vascular Diseases, Institute of Clinical Medicine of the Faculty of Medicine of Vilnius University, Vilnius, Lithuania; Clinic of Cardiac and Vascular Diseases, Centre of Cardiology and Angiology, Vilnius University Santaros Clinics, Vilnius, Lithuania.
Email: Jelena.Celutkiene@santa.lt

Anna Strömberg RN, PhD
Department of Medical and Health Sciences, Linkoping University, Linkoping, Sweden.
Email: anna.stromberg@liu.se

Dan Atar MD, PhD
Department of Cardiology B, Oslo University Hospital Ullevål, Oslo, Norway; Institute of Clinical Sciences, University of Oslo, Oslo, Norway.
Email: dan.atar@medisin.uio.no
Ragnhild Sørum Falk, Statistician, PhD  
Oslo Centre for Biostatistics and Epidemiology, Research Support Services, Oslo University Hospital, Oslo, Norway.  
Email: ragnhild.falk@medisin.uio.no

Thomas von Lueder MD, PhD  
Department of Cardiology B, Oslo University Hospital Ullevål, Oslo, Norway.  
Email: tomvonoslo@yahoo.com

Ragnhild Hellesø RN, PhD  
Faculty of Medicine, Institute of Health and Society, Department of Nursing Science, University of Oslo, Oslo, Norway.  
Email: ragnhild.helleso@medisin.uio.no

Tiny Jaarsma RN, PhD  
Department of Social- and Welfare studies, Linkoping University, Norrkoping, Sweden.  
Email: tiny.jaarsma@liu.se

Irene Lie RN, PhD  
Centre for patient centered heart- and lung research, Department of Cardiothoracic surgery, Oslo University Hospital Ullevål, Oslo, Norway.  
Email: irene.lie@ous-hf.no
Remote patient telemonitoring for heart failure care. Experiences and perceptions of nurses and physicians in a cross-sectional study from the Nordic Baltic Region.

Abstract

Background: Remote telemonitoring (RTM) can be used in heart failure (HF) patients to perform early detection of decompensation at home, prevent unnecessary healthcare utilization, and decrease healthcare costs. Little is known objectively about the daily use of RMT in HF clinical care in the Nordic Baltic region.

Objectives: The aim of this study was to determine how health care professionals’ (HCPs) experience and perceive using RTM in daily HF patient care.

Methods: A cross-sectional survey of physicians and nurses (n=784, response rate 69 %) from 100 local hospitals was performed in Norway and Lithuania. Participants treated HF patients either at hospital ward or an outpatient clinic at. Participants answered closed- and open-ended questions on a 43-items questionnaire between September and December 2016. Chi-square tests were used to analyze quantitative data, and Fisher’s exact test was used for categorical data. Student’s t-test was used for continuous data. Responses to open-ended questions were qualitatively analyzed using summative content analysis.

Results: None of the HCPs routinely used RTM as part of their clinical practice in HF care. While participants agreed that telecare (mobile-phone based, e-devices) can be good follow-up approaches for HF patients, follow-up care through patient visits to a HF clinic or to a general practitioner (GP) were reported as good ways to monitor stable HF patients. HCPs in both countries said that daily RTM feedback to HF patients would be feasible, with those in
Norway more often reporting it as being feasible (51% vs. 25%; \( P < .001 \)). For HCPs of both countries, the top three reasons stated for introducing RTM were (1) to reduce hospitalizations (mean ±SD: Norway, 7.78±2.41; Lithuania, 7.74±2.47); (2) to encourage greater patient self-care (7.75±2.36; 7.61±2.57); and (3) to provide high quality care (7.47±2.79; 7.94±2.57). HCPs in Norway and Lithuania ranked almost the same challenges for implementing RTM, such as lack of financing (69% vs. 90%), lack of equipment (59% vs. 81%), lack of knowledge (38% vs. 73%), and lack of guidelines from health care authorities (17% vs. 61%).

**Conclusions:** Although HCPs reacted positively toward implementing RTM in order to improve care quality for HF patients, RTM is not currently a part of routine HF care in Norway and Lithuania. Enhancing patients’ and HCPs’ knowledge about the utility of RTM and additional funding from health care resources may increase the use of RTM, which over the long term, may decrease healthcare costs in the Nordic Baltic region.

**Keywords:** Nurses; Physicians; Perception; Telemedicine; Heart Failure; Self-care
Introduction

Remote patient telemonitoring (RTM) is defined as “the remote monitoring of patients including use of audio, video, other telecommunication and electronic information processing to monitor patient status at a distance” [1]. With heart failure (HF) patients, RTM can be used to perform early detection of decompensation at home, prevent unnecessary healthcare utilization, and decrease health care costs [2, 3]. HF affects 26 million people worldwide, with a rapidly escalating prevalence in Europe and USA due mainly to an increasingly aging population and improved treatment and survival of patients with cardiac disease [4, 5]. HF is a complex, progressive clinical syndrome characterized by high mortality, high morbidity with high readmission rates (25 % in Europe [4] and 27 % in the USA [6]), and a poor quality of life. RTM has been advocated for patients with HF. Presently, there is sufficient evidence showing that RTM has positive effects on clinical outcomes, such as reducing mortality, HF-hospitalization and all-cause hospitalization, and improving quality of life [7].

As part of their self-care, HF patients are encouraged to monitor themselves at home for early detection of symptoms and signs of deterioration [4, 8, 9]. However, they may lack knowledge on how to monitor and interpret their symptoms, as well as when and where to seek treatment. In addition, they may have limited access to HF services that aid them to actively engage in self-care [10, 11]. A scientific statement from the American Heart Association for healthcare professionals (HCP) presents technology as a promising way to support patients’ self-care and encourages HCPs to have an active role in the development and use of technology to improve active patient and HCP engagement in patient self-care [12]. Moreover, in accordance with a European medical education curriculum, HF nurses are
expected to provide advice about and master skills for using remote monitoring devices. Part of the practical aspect of this education is to teach patients and caregivers about possibilities and limitations of using remote monitoring devices [13, 14].

The rapid development of modern telecommunication technologies implies that a future is possible that will encourage expansion of RTM. Nevertheless, current field-testing of non-invasive RTM has produced conflicting results for home use. Some studies showed that RTM improves survival, reduces HF-related hospitalizations, and significantly has positive effects on quality of life compared with usual care [15-17]. However, other studies [18, 19] found no improvement in readmission or survival for HF patients compared to usual care. A 2015 Cochrane review concludes that non-invasive telemonitoring improves the management and outcomes for HF patients, especially if the access to care or quality of care is low [20].

HCPs have an important role in the implementation of RTM in patients care, but until now, their experience with RTM has been studied only in countries with high-technology competency, such as Sweden, Japan and the Netherlands [1, 21]. However, RTM is not currently implemented in Sweden and Japan, and only partly in the Netherlands, where insurance and governmental policies are not “friendly” toward implementation. The governments of Norway and Lithuanian, by contrast, have approved use of remote medical services in new eHealth strategies [22, 23]. Norway and Lithuania have 5 and 3 million inhabitants, respectively. Norway is a high-income country, in which the healthcare system is funded mainly by public sources [24]. Lithuania has undergone political-, economical- and healthcare system changes. The Lithuania health system is a mixed system, predominantly funded from the National Health Insurance Fund (61 % of funding in 2010), and
supplemented by a substantial state contribution [25]. Although there seems a positive attitude toward using eHealth, little is known on the actual use of RTM in daily HF clinical care in the Baltic region, or in other Nordic countries. We therefore aimed to describe the experiences and perceptions of RTM of nurses and physicians in HF care in Norway and Lithuania.

**Methods**

**Study design and definition**

We conducted a cross sectional survey of HCPs’ experiences and perceptions of non-invasive, remote HF telemonitoring conducted in two countries.

Remote telemonitoring in the survey referred to non-invasive RMT, which is implemented via Internet-based personal device monitoring of body weight, blood pressure, heart rate, dyspnea and other signs and symptoms that would reflect the actual volume status of HF patients. Patients use the devices in their home environment, and the generated data are transferred to healthcare providers over the Internet. The information obtained is presumed to reflect the actual condition of HF patients (contrasted with patients’ self-reports) and includes feedback to patients about their condition. Examples of RTM implemented via only telephone, telephone support, telephone follow-up, or implantable devices/pacemakers were not considered in the survey.

**Study Participants**

The inclusion criteria were nurses and physicians (i.e., HCPs) currently working with HF patients in a hospital ward or outpatient clinic in Norway or Lithuania. They were recruited
from a HCP personnel list of all potential public and private hospitals caring for HF patients in Norway (n=57) or Lithuania (n=50). The former list was extracted from the Norwegian Heart Failure Registry, and the latter from a nationwide list of hospitals in Lithuania. In addition to telephone follow-up, we contacted by post the head of each hospital ward and outpatient clinic for approval. Two nurses and one physician in each ward or outpatient clinic working with HF patients were invited to complete the survey.

**Data collection and Questionnaire**

Data was collected from September-December 2016 using a survey mailed by post. It was sent to 784 physicians and nurses at 107 public and private hospitals providing HF care in Norway or Lithuania. A study researcher in each country (I.T.A and E.L) made one phone call to remind contacted persons at each site (ward or outpatient clinic) about completing and returning the survey.

**Survey Questionnaire**

A 43-item questionnaire (Multimedia Appendix 1) for assessing HCPs perceptions on the use of RTM was developed. It was based on initial versions of a survey that were used by de Vries et al. (2013) [1] and Kato et al. (2015) [21]. The questionnaire used for present study included open- and closed-ended response options and was enhanced with questions to gather HCPs’ characteristics and additional questions to better understand their experiences and perceptions of RTM use in the respective study countries. Language and cultural adjustments in the final version of the questionnaire were made according to the Principles for Good Practice for the Translation and Cultural Adaption Process for Patient-Reported Outcomes Measures. We used the 10 steps described by Wild et al. [26], from preparation to
final report. Face validity (measuring target construction) and content validity (relevance, comprehensiveness and balance) assessments were done [27] by five cardiologists and ten nurses with expertise in clinical HF care in Norway or Lithuania. These professionals deemed that the questionnaire measured the intended HCPs’ experiences and perceptions of use RTM in HF care.

Data Collection

Data on age, gender, years of post-graduate experience, competency in information and communication technology (ICT), and familiarity with RTM were collected by using additional questions. HCPs also were asked what they considered to be good ways for performing follow-up of stable HF patients (e.g., using Internet-based monitoring, home visits by nurse, etc.); their perceptions of funding responsibility; and situations they thought were inappropriate for RTM. Potential RTM user and non-user participants answered detailed similar questions about RTM. HCPs were asked to rate how important 10 statements (e.g., offering higher-quality care, reducing costs, etc.; see Appendix) were for introducing RTM in the care of HF patients: The importance level was ranked on a 10-point scale, ranging from “0” for not important to “10” for very important. Before asking HCPs for their criteria for recommending RTM to their patients asked for the possible purpose of RTM for their HF patients (e.g., NYHA class, admission or readmission), we asked their opinion about the possible purpose of using RTM for their HF patients (e.g., monitoring physical condition and noticing a decline, remote drug titration etc.). Finally, HCPs were asked to state how long of a period they considered appropriate for using RTM, what barriers are presently blocking implementation of RTM (open-ended question), and what requirements they believed are needed to implement RTM.
Data analysis

Statistical analysis

All data were analyzed using the Statistical Package for Social Sciences, version 24 (IBM Corp Released 2016 IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp). Chi-square tests or the Fisher’s exact tests were used for categorical data (numbers or percentages). Means and standard deviations were calculated for continuous variables, and county differences were evaluated by Student’s t-test.

Summative analysis of the qualitative, open-ended data

Answers to the open-ended questions were translated from Norwegian and Lithuanian into English by two independent researchers (I.T.A and E.L). A total of 44 double-spaced pages of transcripts were produced. First, responses were formulated like statements. Transcripts from both countries were thoroughly read to gain an understanding of the words or statements. Four authors (I.T.A, E.L, J.C, I.L) independently re-read the responses to the open-ended questions before reaching consensus on categories and sub-categories. Following Hsieh and Shannon, a summative content analysis was performed with number and percentages for the sub-categories [28].

Ethical consideration

All participants signed a written informed consent prior to participation. The Data Protection officer at Oslo University Hospital, Oslo, Norway and University Hospital Santariskiu Klinikos, Vilnius, Lithuania granted consent to perform the study. Ethical approval was obtained from the Medical and Health Research Ethics in both countries. The study was conducted in compliance with the principles of the Declaration of Helsinki.
Results

Participants

A total of 536 of 784 nurses and physicians (response rate, 69%) at 100 hospitals of the 107 contacted in Norway (n=53) and Lithuania (n=47) participated. Characteristics of the 536 participating HCPs are summarized in Table 1.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Norway</th>
<th>Lithuania</th>
<th>P value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender n (%)</strong></td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Female</td>
<td>167 (74)</td>
<td>278 (90)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>58 (26)</td>
<td>32 (10)</td>
<td></td>
</tr>
<tr>
<td>Age, mean ± SD</td>
<td></td>
<td></td>
<td>.009</td>
</tr>
<tr>
<td>Range 23-76</td>
<td>46±11</td>
<td>48±11</td>
<td></td>
</tr>
<tr>
<td><strong>Education n (%)</strong></td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Higher degree</td>
<td>44 (23)</td>
<td>150 (52)</td>
<td></td>
</tr>
<tr>
<td>Master/Doctoral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor or lower level</td>
<td>149 (72)</td>
<td>138 (48)</td>
<td></td>
</tr>
<tr>
<td><strong>Current work</strong></td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Physician</td>
<td>63 (28)</td>
<td>137 (44)</td>
<td></td>
</tr>
<tr>
<td>Nurse/Specialized nurse</td>
<td>163 (72)</td>
<td>173 (56)</td>
<td></td>
</tr>
<tr>
<td><strong>Post graduate experience, years</strong></td>
<td>18±10</td>
<td>25±11</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>Work time</strong></td>
<td></td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>Full time</td>
<td>91 (42)</td>
<td>159 (53)</td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td>123 (58)</td>
<td>143 (47)</td>
<td></td>
</tr>
<tr>
<td><strong>Hospital level</strong></td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>University</td>
<td>36 (16)</td>
<td>135 (43)</td>
<td></td>
</tr>
<tr>
<td>Second/Third/private</td>
<td>190 (84)</td>
<td>175 (56)</td>
<td></td>
</tr>
<tr>
<td><strong>ICT competency</strong></td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Computer experience, years Mean± SD</td>
<td>22±6</td>
<td>14±6</td>
<td></td>
</tr>
<tr>
<td>Operating system, n (%)</td>
<td>218 (96)</td>
<td>275 (89)</td>
<td>.001</td>
</tr>
<tr>
<td>Programs, n (%)</td>
<td>214 (95)</td>
<td>233 (75)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Programming language, n (%)</td>
<td>54 (25)</td>
<td>40 (13)</td>
<td>.001</td>
</tr>
<tr>
<td>Email, n (%)</td>
<td>225 (100)</td>
<td>300 (97)</td>
<td>.03</td>
</tr>
<tr>
<td>Email mobile phone, n (%)</td>
<td>210 (93)</td>
<td>226 (73)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Internet, n (%)</td>
<td>225 (100)</td>
<td>304 (98)</td>
<td>.025</td>
</tr>
</tbody>
</table>

<sup>a</sup> P values from students t-test or Fischer’s exact test or Chi square test, as appropriate.

Abbreviations: HCP, Health Care Professionals; ICT, Information and communication technology; SD, Standard deviation.

Seventy-four percent of HCPs in Norway and 90% in Lithuania were female; 28% in Norway and 44% in Lithuania worked as physicians. The majority of the Lithuanian HCPs worked in a university hospital in Lithuania (43%), whereas only a minority of their Norwegian
counterparts (16%) did. The mean (SD) postgraduate experience for Norwegian HCPs was 18 (SD 10) years, and that for Lithuanian HCPs was 25 (SD 11) years. All participants had substantial experience with ICT; one difference was the use of email on a mobile phone (93 % in Norwegian vs. 73 % for Lithuanian HCPs; \( P < .001 \)).

**Experiences with RTM and Indications for**

RTM is not a part of routine clinical practice in HF care in Norway or in Lithuania. None of the responding HCPs working in a hospital (n=100) were using RTM. However, 21 % of HCPs in both countries reported being familiar with RTM. HCPs in Norway and Lithuania rated the criteria for possible RTM indication differently. Norwegian HCPs rated support and advice at 41%, whereas Lithuanian HCPs rated it at 22%; \( (P < .001) \). Norwegian and Lithuanian HCPs respectively, differed in their ratings of NYHA class (50 % vs. 62 %; \( P = .006 \)); adherence to medication (43% vs. 55 %; \( P = .011 \)); and admission and readmission (60 % vs. 70 %; \( P = .021 \)).

**Follow-up of HF patients**

As shown in Figure 1, HCPs reported that follow-up by a HF clinic or GP as most optimal way to follow-up HF patients. HCPs in both countries said there is potential for Internet-based telemonitoring, video contact and telephone follow-up. More HCPs in Norway reported that daily feed-back to HF patients using RTM was feasible in Norway than reported by HCP in Lithuania (51% vs. 25%; \( P < .001 \)). More Norwegian HCPs 201 (66%) than Lithuanian HCPs 104 (47 %) answered, “I don’t know” on the question, “How easy/feasible it would be to give daily feedback to patients via RTM?”. The HCPs in Norway and in Lithuania rated the purpose or reason for introducing telemonitoring in future HF care: to recognize signs of worsening heart failure (82% vs. 73%); to monitor effects of the treatment and adjusting it remotely
(62% vs. 73%); to enable remote drug titration (34% vs. 61%); and to educate patients (46% vs. 63%). Regarding the preferred length of RTM use, most HCPs stated that it should be used as long as necessary, or there should be unlimited use (Norway vs. Lithuania, 165 [81%] vs. 262 [84%]).

Figure  HCPs opinion of good ways of performing follow-up of stable HF patients. HCPs in Norway (n=226) and Lithuania (n=310)\(^a\)

\(^a\) More than one answer was possible.

\(P\) value < .05 for all follow-up comparison between Norway and Lithuania, except for General practitioner (GP) (\(P= .53\))

Reasons to consider introducing RTM

The top three reasons given by HCPs in Norway and Lithuania for introducing RTM to HF patients were to (1) reduce hospitalizations (mean±SEM, 7.78± 0.17 vs. 7.74± 0.14); (2) increase patient self-care (7.75± .16 vs. 7.61± 0.14); and (3) offer higher quality care (7.47± 0.19 vs. 7.94± 0.15) (Figure 2). Compared to HCPs in Norway, HCPs in Lithuania rated higher implementing the vision of the hospital (\(P < .001\)) and reducing the workload on the HF
outpatient clinic \( (P < .001) \) for introducing RTM. To improve adherence to guidelines \( (P = .013) \) and to be innovative \( (P = .015) \) were other important reasons Lithuanian HCPs gave for introducing RTM.

**Figure** HCPs ranking of the most important reasons for introducing RTM into clinical practice in Norway and Lithuania (n=536; mean ±SEM).

### Challenges for implementing RTM

HCPs in Norway and Lithuania reported almost the same challenges for implementing of telemonitoring: Lack of financing (Norway vs. Lithuania, 69% vs. 90%); lack of equipment (59% vs. 81%); lack of knowledge (38% vs. 73%); and lack of guidelines from health care authorities (17% vs. 61%). Table 2 shows the perception of HCPs on challenges to implement RTM in both countries in a summative analysis of qualitative open-ended data.
Table Perception of health care professionals on challenges to implement RTM in Norway (n=226) and Lithuania (n=310)*

<table>
<thead>
<tr>
<th></th>
<th>Norway</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes, n (%)</td>
<td>Yes, n (%)</td>
</tr>
<tr>
<td><strong>Financing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health care authorities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional health authorities</td>
<td>123 (54)</td>
<td>87 (28)</td>
</tr>
<tr>
<td>Ministry of health care services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist health care services</td>
<td>25 (11)</td>
<td>85 (27)</td>
</tr>
<tr>
<td>Territorial Patient Fund</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not know</td>
<td>29 (13)</td>
<td>23 (7)</td>
</tr>
<tr>
<td><strong>Patients limitations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental limitations</td>
<td>91 (40)</td>
<td>22 (7)</td>
</tr>
<tr>
<td>Acute or physical limitation</td>
<td>57 (25)</td>
<td>52 (17)</td>
</tr>
<tr>
<td>Age limitations</td>
<td>48 (21)</td>
<td>6 (2)</td>
</tr>
<tr>
<td>Knowledge limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical skills</td>
<td>44 (19)</td>
<td>14 (4)</td>
</tr>
<tr>
<td>Compliance issues</td>
<td>14 (6)</td>
<td>11 (3)</td>
</tr>
<tr>
<td>I do not know</td>
<td>15 (7)</td>
<td>46 (15)</td>
</tr>
</tbody>
</table>

*More than one answer was possible.

In the summative analysis, we found that HCPs in both countries reported that healthcare authorities should be the main contributors of funding for RTM. In Norway this is represented by national and specialized or municipality healthcare authorities and in Lithuania this is represented by Ministry of Health Care Services and Territorial Patient Fund. Less than 5% of HCPs from both countries responded that other options of funding should come from patients, the company, or private sector. HCPs in Lithuanian believed that the European Union could be considered as a possible source of funding. Less than 5% of HCPs in Norway questioned whether there should be funding for RTM.
Patients’ limitations for implementing RTM were reported to be related to their physical or mental condition, young or advanced age, insufficient knowledge of technology, and adherence issues (e.g., an acute HF condition, dementia, and cognitive or physical alterations caused by medication). Less than 5% of HCPs in both countries reported that limitations related to access to healthcare services when using RTM, and patients with foreign language limitation were challenges to RTM implementation. Access to internet was a specific challenge mentioned by the HCPs in Lithuania.

**Discussion**

**Principal Results**

Although new national eHealth strategies in Norway and Lithuania have approved the provision of remote medical services, a key finding of this study is that telemonitoring is not yet a part of routine HF clinical practice in the Nordic Baltic region. This survey significantly contributes to the field by providing a comprehensive picture of HCPs’ experiences with RTM, and also of their expectations of using RTM in their daily follow-up of HF patients.

The findings of this study are in line with previously reported low use and awareness of RTM in clinical practice in Japan and Sweden [21], and also parallels reports of limited use in the Netherlands. In the study of De Vries et al., high expectations for telemonitoring were reported, but HCPs expectations after implementing RTM were not met [1]. This lack of experience with RTM, but at the same time having a positive attitude towards using RTM for patients with HF, places a large responsibility for applying good implementation strategies in the future. Furthermore, Government agencies have addressed this discrepancy in policy pronouncements. The eHealth Action Plan (2012-2020) from the European commission, for
example, states that healthcare is 10 years behind every other domain in implementing IT solutions because of high startup cost and lack of confidence in eHealth solutions among patients and HCPs [29]. This is especially challenging because of an expected increase in the number of HF patients due to an ageing population. RTM for follow-up of symptoms and signs at home has the potential to reduce hospital admissions and healthcare costs.

HCPs in both Norway and Lithuania saw the potential for RTM to support recognizing signs of worsening HF symptoms, monitoring effects of the treatment and adjusting it remotely, enabling remote drug titration, and educating patients. HCPs have positive attitudes towards RTM to reduce patients' hospitalization and increase patients' self-care, although there is a wide range of barriers to be breached for successful RTM implementation [21]. To gain a positive attitude and optimize future use of RTM, a realistic picture needs to be drawn to future users, for HCPs, HF patients, and health care authorities. The European Society of Cardiology (ESC) guidelines for the diagnosis and treatment of acute and chronic heart failure (2016), recently concluded that there is an evidence gap in the role of RMT strategies in HF; an issue that deserves attention in future clinical research [30].

In the present study, HCPs in both Norway and Lithuania reported that healthcare authorities should be main contributors of funding in order to avoid financing setbacks and lack of equipment. HCPs expressed the need for sufficient financial support for RTM to improve implementation, as confirmed in previous studies [20, 31]. The costs of implementing RTM in the management of HF is not clearly reported, varying from low to high costs, depending on whether only equipment, costs, follow-up, or hospital admission costs are considered [15, 32, 33].
One of the reasons for implementing RTM is the importance of self-care by HF patients. This demands that the patient has knowledge of symptom monitoring for early detection of adverse events, recognizes and interprets symptoms, and has treatment options [34]. Effective self-care may lower readmission to hospital and lower mortality rates [35]. However, it is important to acknowledge that that a prerequisite to get access to and use digital technology is eHealth literacy, defined as competencies to use electronic health services. A deficient eHealth literacy may exclude certain persons from the potential advantages of eHealth services [36]. Future research in e-health literacy is challenged to include the viewpoints of HCPs [36]. HCPs competence and acceptance of the relevance of RTM is vital for successful implementation in the clinical setting [32]. HCPs are expected to teach patients and follow-up on remote monitoring devices [13]. Interestingly, although there were mostly similarities in the expectations of HCP in both countries, a higher percentage of HCPs in Lithuania then in Norway said they expected that introducing RTM into clinical practice will reduce the workload on the HF outpatient clinic. More HCPs in Norway then in Lithuania reported daily feedback to HF patients using RTM was expected to be feasible. These differences call for future approach of implementation that is tailored to local expectations and barriers.

**Strength and limitations**

The fairly high response rate is a strength of the study. HCPs from both hospital wards, that discharge patients to home, and outpatient clinics, that see patients who live at home, were asked to participate. There are several limitations in our study. Firstly, the self-reported questionnaire does not provide in depth knowledge about HCPs knowledge of telemonitoring. Secondly, it was not possible to sample HCP experiences with RTM in HF
clinical practice, since none of the hospital were using RTM at the time of the survey. This was not anticipated. This shortfall implies that some items of the questionnaire need to be revised. Furthermore, a comprehensive assessment of face and content validity of the questionnaire may have strengthened the study.

Conclusions

Although RTM is not presently part of routine HF care in Norway and in Lithuania, HCPs express positive attitudes towards implementing telemonitoring to improve quality of care for HF patients. Additional funding from health care authorities and more focused targeting of HF patients may encourage the more widespread use of RTM in the Nordic Baltic region and beyond.

Acknowledgement

We wish to thank all participants in the study in Norway and in Lithuania.

Conflicts of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

This work was supported by NordForsk. Nordic Programme on Health and Welfare, Project no: 76015.
Abbreviations

RTM, Remote Telemonitoring
HF, Heart Failure
HCP, Health Care Professional
ICT, Information and communication technology
NYHA class, New York Heart Association Functional Classification
GP, General practitioner
ESC, European Society of Cardiology

References


