

# Factors Influencing Medication Adherence in Heart Failure Patients—A Survey among Cardiac Healthcare Providers

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Adhering to medication regimens is key behavior to alleviate symptoms and slow disease progression in heart failure (HF). This study explores cardiac healthcare providers' perceptions and experiences of factors influencing medication adherence (MA) in HF patients, with findings contributing to developing a HF-specific MA assessment scale. Using a cross-sectional, mixed methods design, we conducted an online survey with both closed and open-ended questions distributed to cardiac healthcare providers, working at the National University Hospital in Iceland. The survey consisted of 103 questions divided into 18 themes. Analysis included descriptive statistics of the participants' responses to closed responses with simplified scoring. Free-text responses were grouped into thematic categories and then into subthemes. Of 104 healthcare providers invited, 73 (70%) participated. Key factors identified as most beneficial for supporting MA included supportive patient-provider relationships (97%), selecting suitable drug formulation (96%), healthcare support at home (95%), and multi-dose dispensing from pharmacies (93%). The youngest and oldest HF patients were believed to be at the highest risk of medication non-adherence, particularly among males. Other patients estimated at increased risk included those with alcohol and/or substance abuse (89%), those with limited knowledge of medication effects (89%), those perceiving medication as useless (88%), and those with cognitive impairment (86%). Most participants (73%) agreed that healthcare providers should assess and document MA in clinical care. These findings provide a comprehensive overview of factors that cardiac healthcare providers believe influence non-adherence in HF patients, contributing to the development of a HF-specific MA scale.

## Study Highlights

### WHAT IS THE CURRENT KNOWLEDGE ON THE TOPIC?

☑ MA is pivotal for HF treatment, although adherence is low (40–60%). MA is influenced by a variety of variables, but their relative importance from the perspective of cardiac HCPs is unclear. Currently, there is no defined scale for measuring MA among HF patients.

### WHAT QUESTION DID THIS STUDY ADDRESS?

☑ To develop a reliable and validated MA measurement scale, it is important to collect information about those factors believed to influence MA by key stakeholders, including HF patients and HCPs in cardiac care. The present study focuses on the initial stage of this process, evaluating the experiences and perspectives of cardiac HCPs regarding non-adherence of HF patients.

### WHAT DOES THIS STUDY ADD TO OUR KNOWLEDGE?

☑ The study adds valuable insights into the evaluations of cardiac HCPs regarding factors influencing MA in HF

patients. It highlights the importance of patient-provider relationships, appropriate drug formulation, and support from home healthcare and pharmacy in promoting adherence. Additionally, it identifies specific high-risk groups for non-adherence.

### HOW MIGHT THIS CHANGE CLINICAL PHARMACOLOGY OR TRANSLATIONAL SCIENCE?

☑ These findings underscore the critical role HCPs play in assessing and promoting MA among HF patients. By identifying key factors that influence MA, clinicians can better target interventions to support HF patients at higher risk of non-adherence. This research advocates for the integration of MA assessment into routine clinical practice and electronic health records.

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Received September 14, 2024; accepted November 26, 2024. doi:10.1002/cpt.3526

Heart failure (HF) is a chronic, costly medical condition associated with a high mortality rate, ranging from 10% to 50% within the first year following diagnosis.<sup>1</sup> An estimated 64 million individuals worldwide have HF, whereas in developed countries, 20–30% are admitted to hospitals annually.<sup>1</sup> The age-adjusted incidence of HF has decreased, probably due to more efficient care of patients with cardiovascular disease.<sup>2</sup> However, the prevalence continues to rise due to population aging, advances in therapies and prevention, and decreasing case fatality.<sup>3</sup> According to recent research, HF may also become more prevalent in younger age groups, primarily due to Western lifestyle-related diseases.<sup>3</sup> Pharmacotherapy, aimed at alleviating symptoms and delaying disease progression, constitutes the cornerstone of HF treatment. Rapid up-titration of guideline-directed medical therapy (GDMT) and close follow-up after an acute HF admission reduces the risk of all-cause death and HF readmissions.<sup>4</sup> Therefore, adhering to medication regimens is a key behavior for HF treatment efficacy.<sup>5</sup> According to a 2018 Organization for Economic Co-operation and Development (OECD) report, medication non-adherence accounts for nearly 200,000 premature deaths annually, leading to excess healthcare costs of up to 125 billion euros in Europe. The report also highlights the need for accurate and reliable adherence measurement to achieve optimal treatment outcomes.<sup>6</sup>

Various definitions have been used to describe medication-taking behavior. Medication adherence (MA) is defined by the World Health Organization (WHO) as “the extent to which a person’s behavior taking medication corresponds with agreed recommendations from a healthcare provider.”<sup>7</sup> According to WHO, there are multiple factors leading to poor medication adherence, and they are classified into five categories: (1) socio-economic factors; (2) patient-related factors; (3) condition-related factors; (4) healthcare system/health team barriers; and (5) therapy-related factors.<sup>7</sup> Based on a systematic review of the medication adherence literature, Vrijens et al. proposed the Ascertaining Barriers to Compliance (ABC) taxonomy. Providing a more transparent and rigorous approach to examine adherence in its three phases: (1) initiation “patient does not initiate treatment,” (2) implementation “patient delays, omits or takes extra doses,” and (3) persistence “patient discontinues treatment—time to event.”<sup>8</sup>

MA among HF patients is low, ranging from 40% to 60%. This has a detrimental effect on clinical outcomes, leading to increased HF exacerbations, diminished physical function, and a higher risk of hospital admission and mortality.<sup>9,10</sup> A valid, efficient tool for assessing MA in HF patients is needed to identify the underlying reasons for non-adherence and enable the implementation of tailored interventions to improve MA.<sup>11</sup> Generic MA scales (not disease specific) and the few scales developed and validated for other specific patient groups are unreliable and do not take into account the complexity of the heterogeneous medication-taking behavior of HF patients.<sup>11–13</sup> Moreover, many HF patients are treated with 10 or more medications thus enduring a heavy medication burden.<sup>14</sup> This calls for a personalized assessment approach for MA support. Achieving optimal MA is a joint process of communication and understanding between patients and healthcare providers (HCPs).<sup>15</sup> A trusting relationship is crucial for supporting adherence. When patients are actively involved in managing their

medication, they tend to take greater responsibility, improving health outcomes, especially for those with chronic conditions and polypharmacy.<sup>15,16</sup> A survey across 37 European countries revealed that over a third of HCPs reported a lack of clear methods or guidelines for assessing MA, with time constraints and limited resources further complicating efforts.<sup>17</sup> These challenges underscore the need for a collaborative approach where HCPs across specialties work together, using shared data, direct patient communication, medication reviews, and caregiver support. Such collaboration is essential for effectively addressing non-adherence and improving treatment outcomes, particularly for patients with complex conditions like HF.

While much research has focused on patient-related factors influencing MA, there is less attention given to HCPs’ perspectives, especially in HF.<sup>17–19</sup> This study aims to fill that gap by providing a comprehensive overview of the factors believed by cardiac HCPs to influence non-adherence in HF patients, thereby contributing to the development of a HF-specific MA scale.

## METHODS

### Study design

The current study was a cross-sectional mixed-method study. An online survey was designed to assess HCPs’ individual experiences, perspectives, and emphases relating to factors influencing MA in HF patients. Consensus-Based Checklist for Reporting of Survey Studies (CROSS) guidelines were followed when designing, conducting, and reporting the survey.<sup>20</sup> Participation was anonymous and voluntary. Responders consented to participate by answering the survey. Ethical approval for the study was obtained from the National Bioethics Committee of Iceland (license number VSN – b2020090021/03.01) and the Data Protection Authority of Iceland.

### Study population

The sample included all cardiac nurses and cardiologists in the cardiology department, HF outpatient clinic, cardiac catheterization lab, and cardiac emergency department at Landspítali—The National University Hospital of Iceland, the only hospital in Iceland with specialized cardiology and HF services. Notably, a slight majority of the cardiologists in this sample ( $n = 14$ , 58%) also work in private clinics, where they treat additional HF patients.

### Measures

The item pool for the online survey was created by the main investigator (IG) based on relevant questions from the literature, including key studies on MA barriers and facilitators in HF,<sup>7–9,18,21</sup> and clinical experience. Before finalizing the survey questions, the main investigator also held an informal open discussion with three specialist HF nurses and a cardiologist from the HF outpatient clinic to gather their views on the factors influencing MA in HF patients. The survey underwent expert review by the research team, which included clinicians and researchers with a wide range of specialty knowledge, including two clinical pharmacists, three cardiologists (two with a HF specialty), a professor in clinical pharmacy and qualitative research, and a cardiac psychologist. This diverse expertise ensured a thorough review, and adjustments were made based on their feedback regarding the clarity and appropriateness of the questions before distribution. A pilot test of the final questionnaire was conducted with a small sample of HCPs not practicing in the cardiology department.

The survey consisted of one demographic question (professional qualification and years of clinical experience) and 103 questions across 18 themes related to MA. The themes and the number of questions in each

**Table 1** Survey question themes and the number of questions related to each theme

Themes involving medication adherence in the survey	Number of questions
Mental-, social-, and cognitive-related factors	18
Drug- and disease-related factors	13
Pharmaceutical formulation	8
Patients' education and knowledge	7
Polypharmacy	7
Aids to improve MA	7
Patient-provider relationship	7
MA assessment and registration to EHRs	6
Treatment initiation and persistence, duration of therapy, and daily routine	5
Intentional or unintentional non-adherence	4
Medication regimen timing	4
Patients' access to healthcare service	4
Reduced physical ability	3
Importance of support provided at home	3
Age- and gender-related factors	3
Medication side effects	2
Chronic medication users compared to newly diagnosed patient	1
Suggestions of effective ways to improve patients' medication adherence	1

MA, medication adherence; EHRs, electronic health records.

are outlined in **Table 1**. Survey questions primarily used a 6-point Likert scale (ordinal measures), followed by a 3-point Likert scale (yes/no/do not know or not sure), nominal, multiple-choice, interval scale, contingency response options, and sliding scales. Participants were also asked to provide further details on some closed-ended questions in free text and to respond to optional open-ended questions. An English version of the survey can be found in **Supplementary Material Table S1**.

### Data collection

An online survey was administered and distributed using the survey tool Research Electronic Data Capture (REDCap).<sup>22</sup> The study questionnaire was open for participation between October 25, 2021 and December 10, 2021. Reminders were sent to non-responders up to four times during this period.

### Data analysis

The 103 survey questions were classified according to the WHO's *Five Interacting Dimensions that affect Adherence*: social/economic factors, patient-related factors, condition-related factors, health system-related factors, and therapy-related factors.<sup>4</sup> The following questions did not fit within the WHO's classification and were assessed independently: (1) intentional and unintentional non-adherence, (2) assessment of MA in clinical practice, (3) patient prioritization when assessing MA, and (4) methods used to assess MA.

Data analysis included descriptive statistics of the participant's responses to questions. Missing values were excluded from the analysis, that is, participants' responses were included in the analysis on a question-by-question basis, meaning that any unanswered questions were excluded only for that specific item. Consequently, proportions and other descriptive statistics were calculated based on the number of participants who responded to each question, rather than the total sample size, to accurately

reflect response rates per item. As the response options for each question in the survey included different scale types, the scoring was simplified. Responses to 6-point Likert scale questions were dichotomized into low or high effect. Responses indicating no, insignificant/minor, or moderate impact were re-coded as low, while significant or major impact responses were re-coded as high. A third category was created for "do not know" or "have no opinion" responses.

Free text responses were grouped into thematic categories and then further grouped into subthemes. The main investigator (IG) independently thematized this and AIG and ES reviewed the themes independently. Thereafter, all three met to discuss and decide on the final themes and subthemes.

## RESULTS

### Participant characteristics

A total of 104 HCPs were invited; 73 individuals (70%) participated in the study (49 nurses and 24 cardiologists). Of these, ( $n = 59$ ) 81% provided full responses. Overall participation rates were higher among cardiologists (96%) than among cardiac nurses (63%). A higher number of nurses provided partial responses (12 nurses vs. 2 cardiologists). Notably, 56 participants (77%) had  $\geq 5$  years of clinical experience.

### WHO-1: Social and economic factors

**Figure 1** shows which social and economic factors are believed to influence MA. Support from family members at home and disabilities were considered most influential, as 86% and 80% respectively, rated them to have a significant or major influence. On the contrary, unemployment/inactivity, difficulties in personal life (e.g., divorce, death of loved one, moving/house relocation, job loss), and low educational level were believed to have the least influence (15%, 25%, and 29%, respectively).

Over half of the participants (59%) believed that the patient's age influenced MA. A U-shaped curvilinear relationship was observed between age groups, with the youngest and oldest groups rated as having the highest risk of medication non-adherence. Across all age groups, men were found to be more likely than women to be non-adherent, particularly in the youngest age group (below 30 years) (**Supplementary Material, Figure S1**).

A total of 29 (40%) participants answered the open-ended question "In what way do you think family/caregivers and/or healthcare providers can provide support at home for good adherence?" The reasons most frequently mentioned were to remind the patients to take their medications and the timing of the medication regimen ( $n = 16/29$ , 55%), being encouraging and indicating the importance of medications ( $n = 11/29$ , 40%), monitoring medication intake ( $n = 8/29$ , 28%), and assisting the person with taking medications ( $n = 6/29$ , 21%) (**Supplementary Material, Table S2**, part 12).

### WHO-2: Patient-related factors

**Figure 2** shows which patient-related factors are believed to influence MA. The most important patient-related factors were—(1) Lack of knowledge about medication effects, (2) the belief that medications are useless, and (3) cognitive impairment, as 89%, 88%, and 86% of participants, respectively, rated them to have a significant or major negative impact. In contrast, patient-related factors receiving the lowest ratings included perceptions of medications as unnatural (29%) and poor reading comprehension (28%).

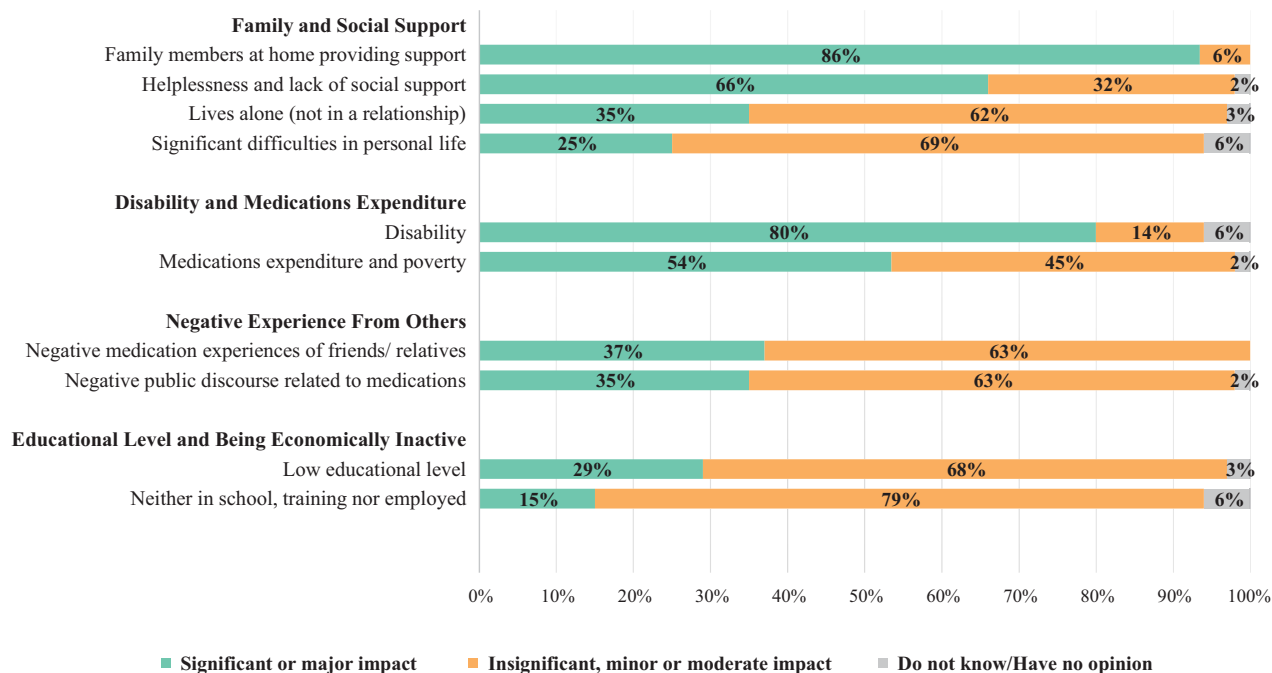


Figure 1 Socioeconomic factors that Icelandic cardiac healthcare providers believe influence heart failure patients' medication adherence.

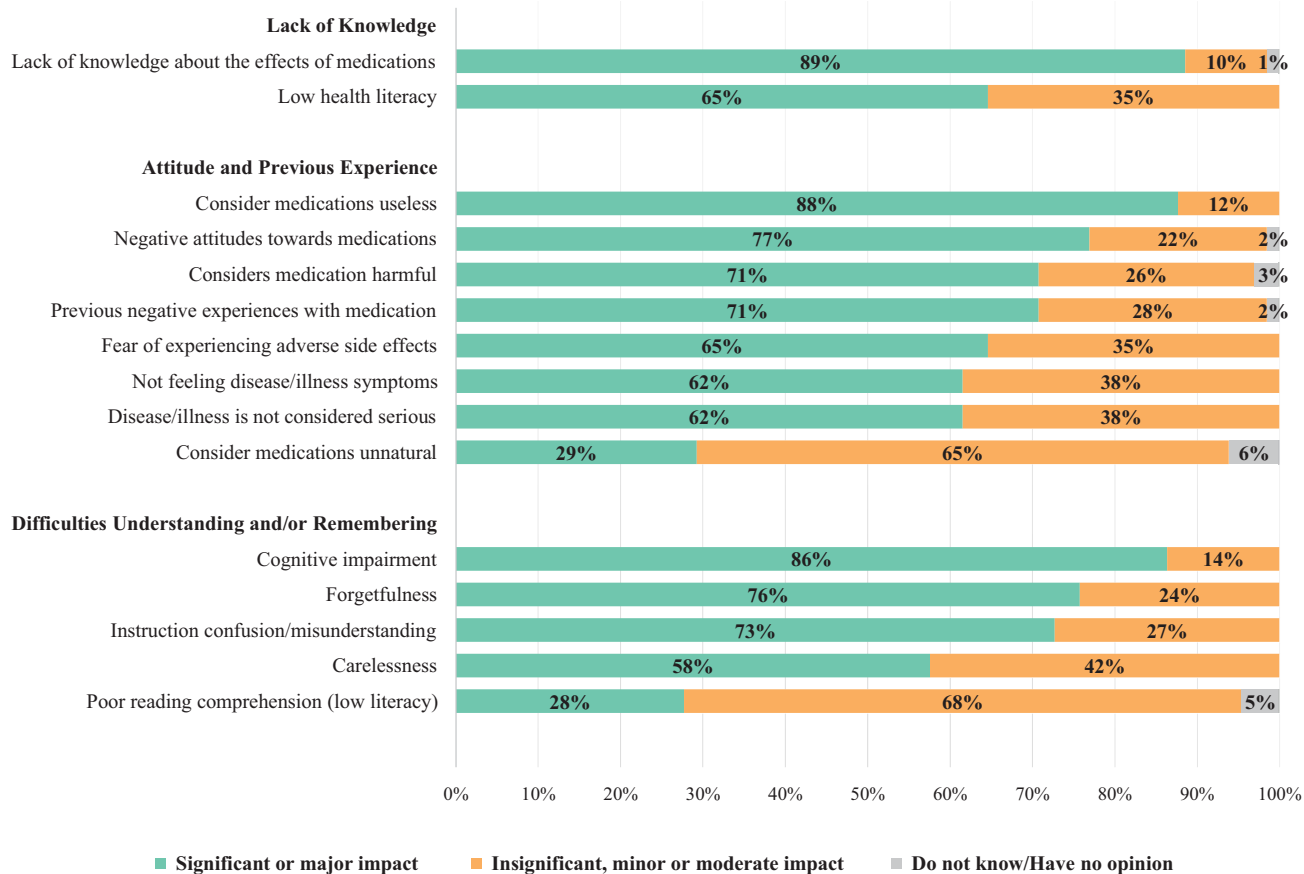


Figure 2 Patient-related factors that Icelandic cardiac healthcare providers believe influence heart failure patients' medication adherence.

**WHO-3: Condition-related factors**

Figure 3 shows which condition-related factors are believed to influence MA. Of those, most participants (89%) rated alcohol/substance misuse to have a significant or major influence on MA. Other factors, listed in Figure 3, were rated lower. When asked about impaired physical ability to take medication, it was considered to have a negative influence on MA by ( $n = 48/73$ , 76%) of the participants. Of those 76%, the majority believed that limited dexterity ( $n = 41/48$ , 85%), poor eyesight ( $n = 41/48$ , 85%), dysphagia ( $n = 41/48$ , 85%), and poor inhalation technique ( $n = 35/48$ , 73%) were the most influential physical limitations (data not shown).

**WHO-4: Health system-related factors**

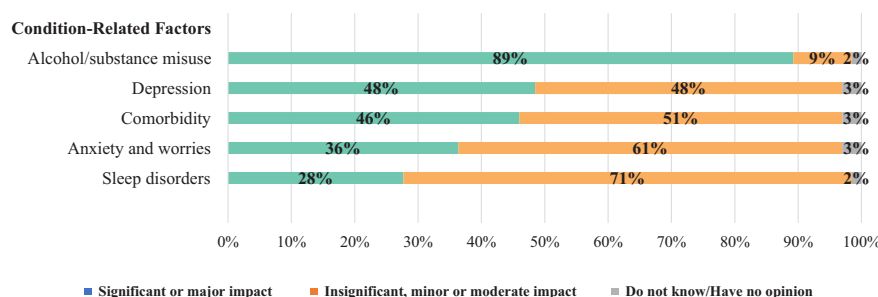
Figure 4 shows which health system-related factors are believed to influence MA. The majority believed nearly all health system-related factors highly influenced MA. The patient–healthcare provider relationship and healthcare support at home were considered most influential, by 97% and 95% of participants, respectively,

rating them as having a significant or major influence. Time spent with HCPs and access to pharmacies and general practitioners were also considered important, rated so by 89%, 86%, and 83% of participants, respectively.

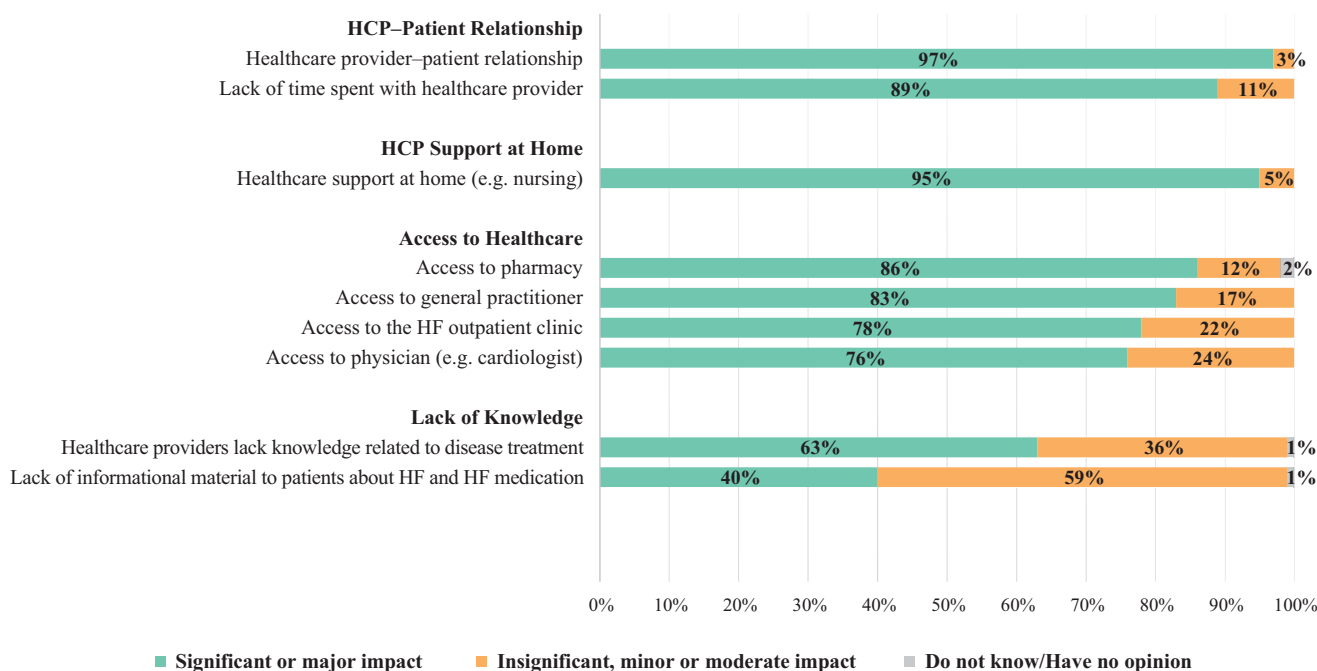
**WHO-5: Therapy-related factors**

Nearly all participants (96%) stated that the necessity to evaluate and choose a suitable drug formulation had a significant or major positive influence on MA. Multi-dose dispensing from pharmacies was rated as a highly influential positive factor on MA by 93% of participants, as were weekly-dose dispensing boxes managed by the patient and/or close relatives (85%). To manage MA, 70–77% of participants considered it important to minimize medication complexity and frequency of medication intake and to adapt the timing to patients' lifestyles and daily routines (Figure 5).

Forty-seven participants answered the contingency open-ended question "If so, which medication times do you consider to be less convenient and what do you believe is the reason?" The answers most frequently mentioned were; increased risk



**Figure 3** Condition-related factors that Icelandic cardiac healthcare providers believe influence heart failure patients' medication adherence.



**Figure 4** Health system-related factors that Icelandic cardiac healthcare providers believe influence heart failure patients' medication adherence. HCP, healthcare provider; HF, heart failure.

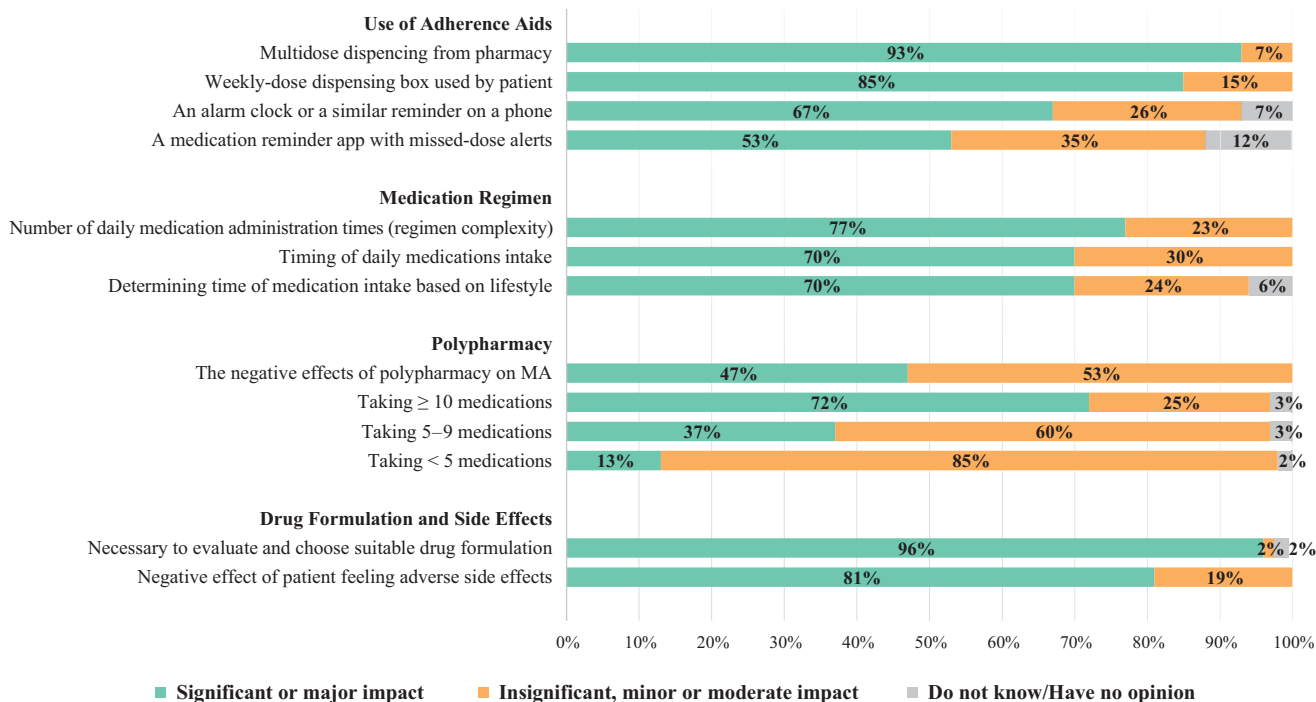
of forgetting medications if taken in the middle of the day ( $n = 32/47$ , 68%), easier to establish a routine if medications are taken in the morning and evening ( $n = 10/47$ , 21%), increased risk of non-adherence if medications are scheduled too early in the morning ( $n = 7/47$ , 15%), Other responses were provided less frequently (Supplementary Material, Table S2, part 5). A total of 65 (89%) participants answered the Likert scale question “How much negative impact do you think fear of experiencing side effects would have on MA?” Of those, 81% of participants ( $n = 53/65$ ) believed they had a significant or major negative impact (Figure 5). Sixty participants answered the multiple-choice question “Do you believe certain drug-related side effects are more likely than others to influence non-adherence?” Nausea was the drug-related side effect rated with the highest risk for non-adherence (88%). Other important side effects included frequent urination (75%), dizziness (75%), fatigue (75%), erectile dysfunction (73%), and sleep disorders or nightmares (71%). Other side effects were provided less frequently (Supplementary Material, Figure S2). Sixty-three participants answered the 3-point Likert scale question “Do you believe polypharmacy has a negative effect on medication adherence?” Most of those participants (84%) believed polypharmacy negatively influenced MA, while (11%) disagreed and (5%) were unsure (data not shown). Of those 84%, almost half (47%) considered polypharmacy to have a significant or major negative impact on MA, and 72% stated that taking 10 or more medications would have a major or significant negative impact (Figure 5). In the open-ended responses, 31 participants ( $n = 31/73$ , 42%) mentioned the following issues related to polypharmacy to affect MA positively or negatively: (1) complexity of the medication regimen ( $n = 14/31$ , 45%), (2) the necessity of having multi-dose dispensing from

pharmacy ( $n = 5/31$ , 16%), (3) the necessity to have a regular medication routine ( $n = 4/31$ , 13%), (4) limited knowledge of the properties of multiple medications ( $n = 4/31$ , 13%), and (5) patient prioritizing to take certain drugs ( $n = 4/31$ , 13%) (Supplementary Material, Table S2, part 4. b)). Conversely, a minority of participants (11%) believed that polypharmacy had a more positive effect on MA than negative.

**Non-WHO categories**

**Intentional and unintentional non-adherence.** A total of 52 (71%) and 49 (67%) participants, respectively, answered the open-ended questions “Now think of cases where patients have shown intentional and unintentional non-adherence. What reasons have they given you?” The reasons most frequently mentioned for intentional non-adherence were side effects ( $n = 29/52$ , 56%), medication believed to be useless ( $n = 22/52$ , 42%), lacking knowledge about medication effects ( $n = 16/52$ , 31%), medication cost ( $n = 12/52$ , 23%), and effects of diuretic ( $n = 11/52$ , 21%). The reasons most frequently mentioned for unintentional non-adherence were forgetfulness ( $n = 32/49$ , 65%), misunderstanding ( $n = 26/49$ , 53%), cognitive impairment ( $n = 8/49$ , 16%), and lacking medication regimen overview and routine ( $n = 7/49$ , 14%) (Supplementary Material, Table S2, part 2. (a) and (b)).

**MA assessment.** Most participants (73%) believed that HCPs should assess and record MA, a few disagreed (7%), and 20% did not know. Nearly half of the survey participants (46%) stated that they estimated MA in over 80% or more of their patient appointments, ~20% said they did so in 60–79% of appointments, 12% in 40–59% of appointments, and 12% in less than 40% of



**Figure 5** Therapy-related factors that Icelandic cardiac healthcare providers believe influence heart failure patients’ medication adherence.

appointments. No one said they never rated MA, but 10% of respondents were unsure if they did.

**Patient prioritization when assessing MA.** More than half of participants ( $n=28/53$ , 53%) who answered the contingency question, “Do you assess adherence equally among all patients or more among a certain group?” believed they assessed MA equally across patient groups. However, 21 participants ( $n=21/53$ , 40%) reported they focused their assessments on specific patient groups. Of those, 19 participants answered the open-ended question “If so, in whom (which patient group to prioritize)?” The most frequent answers mentioned were the elderly with mild cognitive impairment ( $n=10$ , 53%), those who are socially isolated ( $n=6$ , 32%), and those with alcohol and/or substance misuse ( $n=4$ , 21%) (**Supplementary Material, Table S2**, part 14. a).

**Methods used to assess MA.** When assessing MA, nearly all participants (97%) employed indirect questioning to inquire about patients’ medication intake, 71% also consulted patients’ relatives, and 59% utilized clinical measures, such as monitoring blood pressure and conducting blood tests. Less commonly employed methods included reviewing medication refills in the Prescription Medicine Registry (PMR) (48%), inquiring about issues related to medication intake (44%), and ensuring that prescription refills at the pharmacy were regular or timely (41%).

## DISCUSSION

The study results provide a comprehensive overview of the factors believed by cardiac HCPs to influence non-adherence in HF patients. The most beneficial factors for MA were the patients’ relationships with healthcare providers, choosing suitable drug formulation, healthcare support at home, and pharmacy multi-dose dispensing.

Surprisingly, participants viewed certain socioeconomic factors—such as ‘lack of social support’ and ‘disability’—as more influential on non-adherence than education level, financial constraints, or unemployment alone, especially since these factors are often interrelated. Given Iceland’s high levels of education and general prosperity, it is understandable that HCPs might see a lack of social support as a more significant barrier to adherence. Research has shown that lower education levels correlate with poorer health outcomes, particularly for cardiovascular disease,<sup>23</sup> and similar trends have been observed in Icelandic studies.<sup>24</sup> In contrast, a Swedish study found that lower income was more associated with poor health outcomes than education level,<sup>25</sup> suggesting that income could also play a role in influencing MA. Additionally, a systematic review highlights the significant impact of adverse social determinants on MA.<sup>26</sup> These findings indicate that social determinants require greater attention, especially as HCPs may unintentionally contribute to these disparities through inaction or insufficient response. To improve adherence and health outcomes, HCPs need to address social inequities and consider targeted interventions.

In our study, participants also mentioned the need to prioritize older male patients living alone, whereas cohabiting older patients were believed to be more adherent. Previous studies of the elderly

living alone found that patients’ medication-related beliefs and concerns were more powerful predictors of worse MA than the level of education, polypharmacy, and other sociodemographic factors.<sup>27</sup> The respondents in our study believe that MA is lower in the oldest and youngest age groups of HF patients. The effect of age on MA varies across adherence studies of HF patients.<sup>28–30</sup> Enhancing MA in elderly patients is important, especially for those living alone, when comorbidities, complex medication regimens, and cognitive dysfunctions are present; however, supporting younger HF patients is equally important to prevent progression and long-term complications. They are often recently diagnosed and may not accept the HF diagnosis or realize the grave consequences of the disease.<sup>31</sup>

In this survey, cognitive impairment was rated as having a major impact on non-adherence. A review found that older adults with cognitive impairment reported lower adherence than cognitively intact people.<sup>32</sup> The prevalence of cognitive impairment in patients with HF has been reported to be higher compared to the general population, increasing the risk of poorer self-care and non-adherence.<sup>33</sup> In these patients, multi-dose dispensing, alarms, and medication reminder apps can be helpful to instill a medication regimen routine and overview. Participants frequently mentioned that unintentional non-adherence often resulted from forgetting doses or misunderstanding medication instructions. In cases where forgetfulness is a primary issue, such reminder apps, alarms, or structure with medication taking can also be valuable tools, alongside collaborative planning between the HCP and patient through shared decision making to personalize adherence strategies.<sup>34</sup> Other patient-related factors that most study participants believed to affect adherence negatively included patients’ lack of knowledge about medication effects and/or beliefs that the medications are useless or harmful. These factors were also frequently mentioned by participants to be the reason for intentional non-adherence as were side effects and not feeling the benefit of the medication. To improve patients’ adherence and prevent misconceptions and knowledge gaps, it is essential to emphasize educating and empowering these patients.<sup>17</sup>

Alcohol and substance consumption was the most predominant condition-related factor. This may be attributed to alcohol’s dual effect on both the cardiovascular and central nervous systems. Alcohol and substance misuse have been associated with unsuccessful treatment outcomes related to non-adherence among patients with heart diseases, indicating the need for vigilance regarding non-adherence in this patient group.<sup>35</sup> The lower-rated importance of depression on non-adherence may be due to HCP personnel having less knowledge of the negative effects and the inability to screen for depression in clinical practice.<sup>36</sup> The prevalence of major depression in chronic HF is 20–40%, which is two to three times higher than in the general population.<sup>37</sup> Depression and a pessimistic outlook on life, frequently observed in HF patients, are factors likely to influence MA.<sup>38</sup> According to a Danish study, lower health-related quality of life and symptoms of depression at discharge were associated with HF medication non-adherence after 1 and 3 years of follow-up.<sup>39</sup>

From the HCP perspective, health-system-related factors appear to be the most significant drivers of non-adherence. Participants

rated the quality of the patient–HCP relationship as highly important, and they considered the patient’s personal experience and attitude to have a greater effect on non-adherence than influences from friends or relatives. In a supportive patient–HCP relationship, professionals can identify patients’ concerns, experiences, and negative views toward medications and increase shared decision making.<sup>27</sup> Shared decision making can improve treatment decisions, facilitate adherence-promoting interventions, enhance understanding of the reasons for non-adherence, and boost patient’s self-efficacy.<sup>34</sup>

Having healthcare support at home makes patients more likely to receive assistance and reminders to take their medications. Such support can address conditions most respondents in our study believe negatively impact MA, including cognitive impairment, limited dexterity, poor eyesight, advanced age, physical limitations, dysphagia, and fatigue. The early initiation of shared decision making for symptomatic patients is believed to be preventive and to yield greater long-term benefits when underlying conditions, such as economic status, education, and social and community contexts, are considered.<sup>34,40</sup>

Nearly all participants believed that using multi-dose dispensing and selecting the most suitable drug formulation were the most important therapy-related factors that improved adherence. Fixed-dose and extended-release combinations of drug products have been developed to reduce pill burden and simplify medication regimens, thereby promoting adherence.<sup>41</sup> Our findings emphasize the importance of aligning medication schedules with patients’ daily routines to support MA. Most participants highlighted the need to simplify medication regimens, reduce dosing frequency, and tailor medication timing to patients’ lifestyles. A reduction in dosing frequency has been associated with a significant improvement in all three types of adherence (intake, regimen, and timing).<sup>42</sup> Open-ended responses suggested that midday doses are often difficult to remember, while morning and evening doses fit more naturally into routines. Few participants noted early morning doses as a potential barrier, indicating a need for flexible timing options. Participants also described situations where conflicting medication schedules, such as frequent urination due to diuretics, led to skipped doses. For these cases, HCPs could work collaboratively with patients to find individualized solutions, such as modifying the timing to when patients are likely to be at home or adjusting the dosage to once daily if appropriate. This collaborative approach may reduce disruptions to daily life. These insights align with research linking higher medication complexity with lower adherence, underscoring the value of fixed-dose combinations and simplified regimens to enhance adherence in chronic conditions.<sup>43,44</sup>

Unsurprisingly, side effects (especially nausea and frequent urination) and polypharmacy were identified as therapy-related factors that lead to poor MA in this study. However, there are mixed results in the literature regarding the association between polypharmacy and MA.<sup>45,46</sup> Reviewing medication lists, prescribing appropriate drugs, and minimizing the number of medications are believed to reduce the risk of interactions and side effects.<sup>43,46,47</sup> A recent meta-analysis reported an association between a higher degree of medication complexity and non-adherence.<sup>43,44</sup> In this study, open-ended responses indicated that frequent urination—related to factors such as mobility issues, restroom proximity, age, and obesity—was a noted reason for HF patients to skip diuretics. While

participants rated nausea as a high risk for non-adherence, it is not typically a side effect of GDMT or diuretics in HF treatment. Other side effects, such as renal dysfunction, hyperkalemia, hypotension, fatigue, and bradycardia, are more frequently reported and are primarily associated with the medication’s effects or the underlying condition.<sup>48,49</sup> Participants in our study noted that these known side effects, particularly hypotension, fatigue, and dizziness, can significantly impact adherence. Some symptoms, like nausea and fatigue, tend to be especially memorable to patients, possibly due to their general familiarity with these effects from other treatments.<sup>50</sup> This may explain why participants rated these symptoms highly, regardless of the actual frequency. To optimize MA, it is crucial to tailor treatments—including GDMT and loop diuretics—to each patient’s tolerance level.<sup>48</sup> Guidelines recommend prescribing the lowest effective dose of loop diuretics to manage fluid retention while gradually titrating GDMT.<sup>51</sup> Regular monitoring allows for adjustments to minimize side effects.<sup>48,49</sup> Adherence may improve when patients receive a manageable list of side effects. Clear, concise information is more likely to encourage adherence, while an overwhelming list may lead to skipping doses.<sup>50</sup> Addressing patients’ concerns about side effects and customizing treatments to better align with their lifestyle may help reduce non-adherence.

These findings highlight the essential role HCPs play in assessing and promoting MA among HF patients. By identifying key factors that influence adherence, clinicians can more effectively target interventions for HF patients at higher risk of non-adherence. Developing a HF-specific MA scale could support more precise and impactful strategies to enhance adherence, potentially improving clinical outcomes and reducing HF-related hospitalizations and mortality. A multidisciplinary working group from the National Institute on Aging, the American College of Cardiology, and the American Geriatrics Society prioritizes assessing MA in older adults with heart disease and advocates for integrating MA measures into clinical care and electronic health records (EHRs).<sup>13</sup> While most participants in our study also supported integrating MA assessments into clinical care and documenting them in EHRs, fewer than half reported routinely assessing MA in the majority of patient appointments, employing a variety of methods. This gap may stem from barriers such as limited time, lack of clear guidelines, little training and potential inertia in adopting adherence-focused practices.<sup>17</sup> Incorporating other HCPs, such as nurses and pharmacists, in the MA assessment process and collaborating with patients or caregivers to address non-adherence is seen as a valuable approach.<sup>17,18</sup> Effective collaboration with general practitioners and other HCPs could lead to a more comprehensive, multidisciplinary support system for HF patients. These findings underscore the importance of integrating structured MA assessments and multidisciplinary involvement within clinical workflows, facilitating more consistent adherence support across the care team. Our study provides a detailed overview of the factors that cardiac HCPs believe influence non-adherence in HF patients, offering a foundation for improved clinical practices.

### Strength and limitations

The results of the current study need to be interpreted considering its limitations. Firstly, the data were based on self-report, making them susceptible to recall bias, social desirability bias, and

non-response bias. Secondly, the sample size was relatively small, which may affect measurement accuracy. However, it represents a large majority of practicing cardiologists and cardiac nurses from the only university hospital in Iceland with a cardiology service, providing a comprehensive view of these providers' perspectives.

Additionally, the study was limited to HCPs at a single location who worked under similar clinical protocols and guidelines, likely with comparable technical training. This uniformity may have influenced the findings, as perspectives from other settings or specialties, such as pharmacists, were not included. Including clinical pharmacists, who are often well-positioned to address MA, would have been valuable; however, the only clinical pharmacist in this cardiology department at the time of the survey was the study's principal investigator. This limitation highlights an important area for future research, especially in Western Europe, the United States, and Australia, where clinical pharmacists play a more established role and more routinely collaborate with HCPs in managing conditions such as HF.<sup>52</sup>

Finally, a team of researchers, pharmacists, and clinicians with insight into the subject and responder backgrounds generated the survey questions, which may have influenced the phrasing and response options. The mixed-method approach allowed for triangulation of results, strengthening their interpretation. Lastly, Iceland, with fewer than 400,000 inhabitants, has a homogeneous population characterized by a high level of education and general prosperity, which may limit the generalizability of the study's findings to other countries.

## CONCLUSIONS

The study provides a comprehensive insight into cardiac HCPs' evaluations of the factors influencing MA in HF patients. The patient–HCP relationship, suitable drug formulation, and support from home healthcare and pharmacy are of vital importance, addressing multiple individual factors influencing MA. Currently, each cardiac HCP in Iceland individually and arbitrarily decides which method to use and whom to assess for MA. The results will contribute to the generation and development of a HF-specific MA scale to be used in the clinic.

## SUPPORTING INFORMATION

Supplementary information accompanies this paper on the *Clinical Pharmacology & Therapeutics* website ([www.cpt-journal.com](http://www.cpt-journal.com)).

## ACKNOWLEDGMENTS

The authors sincerely thank all participants for their invaluable contributions to this study. Special thanks to Prof. Martin Ingi Sigurdsson MD PhD and Inga S. Thrainsdottir MD PhD for their insightful discussions and valuable feedback on the manuscript. This research was conducted at the Departments of Cardiology and Clinical Pharmacy at Landspítali-The University Hospital of Iceland, with the generous support of healthcare professionals and administrators.

## FUNDING

This work was supported by Landspítali University Hospital Science Fund [Grant No. A2023-031, A2022-027, and A2021-031], the University of Iceland Research Fund, and the Helga Jonsdottir and Sigurlídi Kristjánsson Memorial Fund.

## CONFLICTS OF INTEREST

The authors declared no competing interests for this work.

## AUTHOR CONTRIBUTIONS

I.G. wrote the manuscript; I.G., I.J.I., K.A., A.B.A., and E.S. designed the research; I.G. performed the research; I.G., E.S., A.I.G., I.J.I., K.A., A.B.A., and H.E. analyzed the data.

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