A guideline-based computerised decision support system (CDSS) to influence general practitioners' management of chronic heart failure

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ABSTRACT

Objectives To explore the influence of a guideline-based computerised decision support system (CDSS) on general practitioners' (GPs’) management of patient cases of chronic heart failure in a pragmatic clinical situation. We assessed changes in the GPs’ confidence in the diagnosis, their considerations about investigations and medications and the support they perceived from using the CDSS.

Study design Five GPs assessed the medical records of 48 of their own authentic patient cases using a guideline-based CDSS accessible on the internet for the diagnosis and treatment of chronic heart failure, and completed a questionnaire for each case.

Outcome measures Number of cases where the GP reported a change in confidence in the diagnosis, where the GP considered further investigations or changes in medication and the perceived support marked on a visual analogue scale.

Results The GPs’ confidence in the diagnosis changed in 25% of the cases, with equal numbers of increases and decreases in confidence. The GPs considered further investigations in 31% of the cases and medication changes in 19%. Fourteen of the 31 considered investigations and four of the ten considered changes in medications which were in agreement with the CDSS’s suggestions. The GPs tended to consider further investigations more often in cases when the CDSS found the diagnosis uncertain. There was a wide range in the values for perceived support, but it could be described as substantial in 35% of the cases.

Conclusion Using a guideline-based CDSS for the GPs' own patient cases had an impact on the GPs' confidence in the diagnosis of chronic heart failure and their considerations about investigations and medications: they also perceived substantial support in every third case. Applying a CDSS developed using evidence-based guidelines for chronic heart failure in primary care could have a significant influence on GPs’ disease management.

Keywords: computerised decision support systems, guideline implementation, primary care
Introduction

Computerised decision support systems (CDSSs) have become well-known tools for enhancing evidence-based decisions in clinical practice. According to several studies, CDSSs have the potential to influence clinicians’ decision-making and to facilitate the implementation of new disease management strategies in everyday clinical work, as they integrate individual patient data with evidence-based recommendations.1–6

Despite large investments in developing and implementing evidence-based clinical practice guidelines, guidelines are still not used optimally by practitioners.7 Several studies show that they are used more when they are presented in computerised form, when patient-specific advice is given and when they are integrated with clinical activities.8–11 Evaluation studies are, however, mostly performed in experimental settings and rarely use a naturalistic design with real patients.12 The results of the studies performed in clinical settings have varied and only a few have shown improved adherence to guideline recommendations and better patient care.13–18 The views of users regarding the functioning of the CDSS, its relevance and its helpfulness in decision making are of importance to the success of guideline-based CDSSs.19 Studies focusing on how a CDSS influences clinicians’ reasoning in authentic patient cases are scarce.

Chronic heart failure (CHF) is a common condition, especially among the elderly, and is associated with high mortality and morbidity. The burden on the health care system resulting from the management of CHF is rising in parallel with the increasing proportion of elderly persons in the population. In Sweden, CHF is mostly managed at primary healthcare (PHC) centres. Its management is often complex and both over-diagnosis and under-diagnosis are common.20 The guidelines for treatment of CHF have been revised in the past few years but GPs’ adherence to the guidelines is insufficient.21 CHF is therefore an important field for studies about the influence of a guideline-based CDSS on GPs’ clinical performance.

The aim of this study was to explore the influence of a CDSS on GPs’ confidence in the diagnosis and their considerations about investigations and medications in their own patient cases of CHF. A secondary aim was to explore to what extent the GPs perceived using the CDSS as supportive.

Material and methods

Setting and participants

The study was performed in February 2005 at a PHC centre in a suburban area of Stockholm with approximately 6500 inhabitants. Six female GPs worked at the PHC centre, including one of the authors (ETP). The remaining five participated in the study. They had between three and 27 years of clinical experience in PHC. None of the GPs had indicated having any specific interest in the management of CHF.

The PHC centre had used an electronic patient record (EPR) as the sole medical record since 1994. The present EPR was introduced in 1999, and included patient records only from that time and forward. Notes on diagnoses followed the International Classification of Diseases (ICD-10). The recording of a diagnosis in each encounter note was recommended but not mandatory. None of the GPs had more than an average interest in computers either privately or professionally. Before this study, no CDSSs had been used on a consistent basis at the PHC centre.

Selection of CHF cases

We identified the medical records of all patients who had had the diagnosis ‘heart failure’ (ICD-code: I50-) recorded during the last five years by searching the database of the EPR system. Thereafter we selected those who were still being treated for their CHF problems at the PHC centre (that is, excluding the patients who had died or whose CHF problems were being managed elsewhere). Forty-eight patients fulfilled those criteria. For each case we then identified the encounters in the medical records where the diagnosis or symptoms associated with CHF were noted and selected one of the latest of those encounters. We allocated each case exclusively to the GP who had seen the patient at that encounter.

The CDSS

The CDSS used, Evibase,22 was a web-based application written in Swedish and freely accessible on the internet.23 It comprised four separate modules, all with the same basic structure.24 In this study we used the diagnostic and the treatment modules for the management of CHF, based on three evidence-based clinical guidelines published earlier in paper form.24–26 The two modules could be used independently of one another. Both contained a form with check boxes for patient data that the user had to fill in before triggering the program. The result sheet appeared on screen immediately and was printable on demand. It always contained a list of all the entered patient data for a second check and it was possible to go back and make changes. After closing the window or starting a fresh form, no data from the previous case were stored.

In the diagnostic module, the form for patient data contained boxes with symptoms and signs, examination
results and aetiological factors (see Figure 1). The result sheet presented short, concise statements structured in paragraphs. The first paragraph stated the presence or absence of symptoms, objective evidence (that is, impaired cardiac function on the echocardiogram) and aetiological factors supporting the diagnosis of CHF in the present case. The second paragraph gave a suggestion on the probability of CHF with five alternatives:

1. ‘CHF is present’ occurred when both symptoms and objective evidence were present
2. ‘asymptomatic dysfunction’ occurred when objective evidence was present without any symptoms
3. ‘suspect CHF’ occurred when symptoms were present but echocardiography was not performed
4. ‘CHF is not present’ occurred when the result of the echocardiogram was normal
5. ‘not possible to calculate’ occurred when there were no symptoms and echocardiography was not performed.

The third paragraph contained comments on the entered patient data, their impact on the probability of CHF and suggestions for further investigations.

Since the principal diagnostic investigation is echocardiography, if the box ‘ejection fraction missing’ was marked in the form, the result sheet always included a suggestion to perform echocardiography. Taking a blood test, brain natriuretic peptide (BNP), could also be suggested as a complementary investigation. In addition to echocardiography and BNP, there could be the suggestion of an exercise test as a further investigation for breathlessness.

In the treatment module there was an assumption that CHF was present. It provided suggestions on suitable drugs for additional treatment. Its form for patient data comprised checklists for:
- functional classification according to the New York Heart Association’s scale (NYHA I–IV)
- related medical conditions
- medications
- drugs not tolerated by the patient.

The result sheet gave suggestions on groups of drugs suitable for adding to those already used. Furthermore, there was a list of advantages and disadvantages of all the theoretically usable drugs in the present case, listed in order of importance. The user could repeat

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**Figure 1** The form for patient data in the diagnostic module of the CDSS (Evibase®) (translated to English)
the inquiry for additional suggestions on the same case up to a maximum of five repetitions.

Thus, in addition to the tangible suggestions on how to proceed in the present case, the result sheet for both modules also provided information on the most important rules underlying the calculation of each suggestion. In this way the CDSS also functioned simultaneously as an educational tool.

Training and performance

The GPs attended a demonstration of the CDSS program lasting one-and-a-half hours. They were thereafter asked to carry out an assessment of the selected cases using both the diagnostic and treatment modules of the CDSS (9–11 cases per GP). After having run a test case together with the study instructor, who was subsequently available for technical support, the GPs worked alone in their offices. The GPs were instructed to perform as if the selected encounter were taking place now and for every case to fill in a questionnaire directly after using each module of the CDSS. There were five paragraphs in the questionnaire regarding:

1. whether the GP would consider further investigations (with the options: ECG, exercise test, echocardiography, S-BNP, chest X-ray, spirometry or other specified investigation)
2. whether her confidence in the diagnosis increased, decreased or was unchanged
3. whether she would consider some changes in medications, and if so what kind
4. the overall support from the CDSS perceived by the GP in the present case (marked on a 100 mm visual analogue scale (VAS), where 0 mm was marked ‘no support at all’ and 100 mm was marked ‘the maximum support I can imagine’)
5. the GP’s comments on the assessment of the present case.

The GPs were also asked to collect all the print-outs of the result sheets from the CDSS.

Ethical approval

This study was approved by the Regional Ethical Review Board in Stockholm.

Results

The diagnostic module

The mean age of the patients was 81 years and 60% of them were men. Symptoms of CHF were present more often than clinical signs (in 65% and 42% of the cases, respectively; see Table 1). The echocardiogram showed an impaired heart function in 42% of the cases (‘impaired left ventricular ejection fraction (LVEF)’ or ‘diastolic dysfunction’). No echocardiogram result was found in 31% of the cases. The CDSS’s diagnostic suggestion was ‘CHF is not present’ in 27% of the cases. The suggestions on further investigations included echocardiography in 31% and a supplementary BNP test in 17%.

The GPs’ responses showed that their confidence in the diagnosis was influenced by the CDSS in 25% of the cases, with equal numbers of increased and decreased confidence (see Table 1). The GPs considered further investigations in 15 cases (31 investigations in total of which 14 were echocardiography).

The treatment module

The patient data contained an NYHA classification in 71% of the cases (see Table 2). Most of the patients (52%) were prescribed between one and three drugs of the type used for CHF. Diuretics were most common (85%), followed by betablockers (58%) and ACE inhibitors (44%). The most common related medical conditions were coronary heart disease and fluid retention.

ACE inhibitors were the additional medication most frequently suggested by the CDSS (23%), and the GPs considered making changes in medications in 19% of the cases. The change most frequently considered was addition of ACE inhibitors (in five cases). In 42% of the cases the CDSS could not find any suitable additional medication at all.

The perceived support

The mean rank value for the support perceived by the GPs was 15 mm (range 0–81 mm). In six cases the perceived support was marked as zero (by two GPs). The individual values for four of the GPs fell into two intervals with a gap between, one below 40 mm and the other 40 mm and above (see Figure 2). Therefore, we regarded a value equal to or above 40 mm as representing substantial support. According to this interpretation the perceived support was substantial in 17 (35%) of the cases, and there was only one GP who had no value in this range. We could not see any association between years of clinical experience and perceived support, except that the GP with the shortest clinical experience seemed to perceive generally higher support than the others.

The GPs’ considerations versus the CDSS’s suggestions

We grouped the GPs’ considerations about investigations according to the CDSS’s diagnostic suggestions (see Table 3). When the suggestion was ‘suspect
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CHF’ or ‘not possible to calculate’, the GPs considered investigations in 67% of the cases, whereas they did so in 23% of the cases when the suggestion was ‘CHF not present’ and in 14% and 15%, respectively in the remaining two groups. Of the 31 investigations considered by the GPs, 14 were in agreement with the CDSS’s suggestions. The GPs considered ten of 15 suggested echocardiographies and two of eight S-BNPs. In addition, the GPs also considered 17 investigations not suggested by the CDSS (four echocardiographies, Table 1

<table>
<thead>
<tr>
<th>Patient data</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF symptoms’</td>
<td>None</td>
<td>17</td>
</tr>
<tr>
<td>1–3 symptoms</td>
<td>31</td>
<td>65</td>
</tr>
<tr>
<td>Clinical signs present at the visit</td>
<td>None</td>
<td>28</td>
</tr>
<tr>
<td>At least one sign</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>Result of the echocardiogram</td>
<td>a) Impaired LVEF</td>
<td>18</td>
</tr>
<tr>
<td>b) Diastolic dysfunction</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>c) Normal echocardiogram</td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td>d) No result found in the records</td>
<td>15</td>
<td>31</td>
</tr>
</tbody>
</table>

The CDSS’s suggestion

Suggestions on the diagnosis

CHF is present | 13 | 27 |
Asymptomatic dysfunction | 7 | 15 |
Suspect CHF | 12 | 25 |
CHF is not present | 13 | 27 |
Not possible to calculate | 3 | 6 |

Suggestions on further investigations

No further investigations | 27 | 56 |
1–3 further investigations | 21 | 44 |

Kind of investigations:

Echocardiography | 15 | 31 |
BNP | 8 | 17 |
Exercise test | 14 | 29 |

The GPs’ responses

Changes in the GPs’ confidence in the diagnosis

No change | 36 | 75 |
Less confident | 6 | 12.5 |
More confident | 6 | 12.5 |

The GPs’ considerations on further investigations

No investigation | 33 | 69 |
1–4 investigations | 15 | 31 |

Kind of investigations:

Echocardiography | 14 | 29 |
ECG | 4 | 8 |
Chest X-ray | 6 | 13 |
BNP | 5 | 10 |
Exercise test | 2 | 4 |

1 Fatigue, breathlessness, dyspnoea or cough at night; 2 Tachycardia, pulmonary crepitation, peripheral oedema; 3 LVEF (Left Ventricular Ejection Fraction) was regarded as ‘normal’ when >50%; 4 This answer occurred when the GP marked ‘no symptoms’ and ‘ejection fraction missing’ in the form; 5 There could be several investigations suggested and/or considered in the same case; 6 BNP was suggested as a complement to echocardiography; 7 Exercise test was suggested when breathlessness was recorded as a symptom by the GP and the CDSS’s conclusion on the diagnosis was ‘no CHF’ or ‘suspect CHF’.
Table 2. Results from the treatment module of the CDSS including patient data recorded in the forms, the CDSS’s suggestions on the result sheets and the GPs’ responses in the questionnaire, given as number of cases (n) and (%) of all cases (n=48)

<table>
<thead>
<tr>
<th>Patient data</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification of function according to NYHA (I–IV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYHA I</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>NYHA II</td>
<td>18</td>
<td>38</td>
</tr>
<tr>
<td>NYHA III</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>NYHA IV</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Not recorded</td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td>Module not used</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of CHF drugs recorded per patient (median=3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>1–3</td>
<td>25</td>
<td>52</td>
</tr>
<tr>
<td>4–6</td>
<td>18</td>
<td>38</td>
</tr>
<tr>
<td>Module not used</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Drugs recorded (one or more per patient)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diuretics</td>
<td>41</td>
<td>85</td>
</tr>
<tr>
<td>Betablockers</td>
<td>28</td>
<td>58</td>
</tr>
<tr>
<td>ACE inhibitors(^1)</td>
<td>21</td>
<td>44</td>
</tr>
<tr>
<td>ARB(^2)</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Related medical conditions (one or more per patient)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>25</td>
<td>52</td>
</tr>
<tr>
<td>Fluid retention</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>Asthma/COPD(^3)</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Aortic or mitral stenosis</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Hypotonia</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>The CDSS’s suggestions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CDSS’s suggestions on additional medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACE-inhibitors</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Betablockers</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Potassium-sparing diuretics</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Cannot find any</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>Module not used</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>The GPs’ responses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The GPs’ considerations on change in medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td>39</td>
<td>81</td>
</tr>
<tr>
<td>One change</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Two changes</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Kind of changes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add ACE inhibitor</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Add cardiac glycosides</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Withdraw a drug</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Change of dosage</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) ACE = Angiotensin-converting enzyme; \(^2\) ARB = Angiotensin II receptor antagonists; \(^3\) COPD = Chronic obstructive pulmonary disease
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There was agreement between the GPs’ considerations about changes in medications and the CDSS’ suggestions in four of the ten considered changes.

The GPs’ comments

The GPs wrote comments on a total of 29 cases. We could distinguish two main categories: one was dealing with the CDSS itself and one with its use in the clinical situation. Among the comments on the CDSS itself, three concerned the fact that the check boxes for ECG in the diagnostic module did not cover all possible pathological variations. Two comments concerned the fact that the program did not accept a certain drug combination that was prescribed in line with existing local routines. The GP had to withdraw one of the drugs in order to proceed. In one of those cases the GP chose to quit the treatment module instead (‘module not used’ in Table 2). Two comments described the program as suggesting treatment which had already been input as existing medication for the patient. That happened if the GP asked for more suggestions when

**Figure 2.** Distribution of the marks for perceived overall support reported by the GPs on a 100 mm visual analogue scale. The smallest dots represent one mark, the medium dots two marks and the largest dots three marks each.

**Table 3** Changes in the GPs’ confidence in the diagnosis and the GPs’ considerations regarding further tests in relation to the CDSS’s diagnostic suggestions (n=48)

<table>
<thead>
<tr>
<th>The CDSS’s suggestions on the diagnosis</th>
<th>Changes in the GPs’ confidence in the diagnosis</th>
<th>Proportion of cases where the GP considered further investigations in each group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change in the GPs’ confidence in the diagnosis</td>
<td>Proportion of cases where the GP considered further investigations in each group</td>
</tr>
<tr>
<td></td>
<td>More confident</td>
<td>Less confident</td>
</tr>
<tr>
<td>‘CHF is present’ (n=13)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>‘Asymptomatic dysfunction’ (n=7)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>‘Suspect CHF’ (n=12)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>‘CHF not present’ (n=13)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>‘Not possible to calculate’ (n=3)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All cases (n=48)</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
the program had replied in the previous step that there were no suggestions.

Among the comments dealing with the clinical situation, eight described circumstances overshadowing a potential CHF, so the GP did not feel justified in considering the CDSS's suggestions (patients who had died since the last visit, had other severe conditions or were very old and without symptoms). In seven cases, the GP intended to await the results from the investigations before making any decisions on medications. In four cases there was an assenting comment to the program’s suggestions (for example, 'Very appropriate in this case to perform a new echocardiography now'). Two comments mentioned that the patient also visited a cardiologist and one that the patient would not accept more drugs.

Discussion

Using a guideline-based CDSS for the GPs’ own patient cases influenced the GPs’ confidence in the diagnosis of CHF, their considerations about investigations and their considerations about medications. The GPs’ overall perception of support could be regarded as substantial in more than every third case.

The diagnostic module

The finding that the GPs’ confidence in the diagnosis changed in every fourth case after using the CDSS is in line with other studies assessing clinicians’ confidence in their responses to clinical questions before and after using computerised evidence systems.27,28 In our study the GPs considered further investigations in 67% of the 15 cases where the diagnosis was uncertain (‘suspect CHF’ and ‘not possible to calculate’). This proportion was considerably lower (15%) in the cases where the CDSS’s suggestions included a confirmed diagnosis and no further investigations (‘CHF is present’ and ‘asymptomatic dysfunction’). This could reflect the CDSS’s influence on the GPs’ considerations. Regarding the GPs’ adherence to the CDSS’s suggestions in each case, they accepted fewer than every second suggestion but considered almost as many others. One reason for that could be that the CDSS did not take into account the date of the previously performed investigations, while the GPs probably did.

The treatment module

The proportion of cases where the GPs considered a change in medication was lower in our study than findings reported by Subramanian showing adherence to treatment suggestions of a CDSS in 30% of the cases with a previously confirmed diagnosis of CHF.17 The reason for this could be that the CDSS in our study presented suggestions on additional medications whenever it was possible to find one that was suitable, as the treatment module worked on the presumption of an insufficiently treated CHF. The GPs, however, might have found that additional medication was not justified in the situation or might have preferred to await the results from the considered investigations. Many of the GPs’ comments described this discrepancy and we therefore think that it would have been more efficient to use the two modules on separate occasions.

There were 20 cases in our study where the CDSS did not find any suitable medication to add, which could indicate that those patients were already being optimally treated or the cases were too complicated for the program. Further, another perceived shortcoming was that the CDSS could not give advice on the question of which was preferable, adjusting the dosage of drugs already prescribed or prescribing an additional drug, as this decision often depends on how the patient tolerates the drugs. This implies that decision making in chronic disease management is often complicated and that it is not always possible for a computer program to cover this process completely.29

Perceived support and the GPs’ comments

There was a wide range in the individual values for the perceived support on the VAS-scale (from 0 to 81 mm), implying that the perceived support was dependent on the specific case, rather than on the CDSS itself. Generally, the values were more often within the higher range when the GPs reported improved confidence, when they considered further investigations and when they made an assenting comment. That could imply that when the CDSS provided confirmation or ideas that were new to them, the GPs appreciated this. We have found only a few studies assessing what kind of feedback from a CDSS increases user satisfaction and it seems that users appreciate patient-specific advice more than only general textual information,30 and especially when assessing more complicated cases with several concomitant diseases and medications.31 In our study the users seemed to react most positively when they felt that the CDSS was filling in gaps and stimulating further reasoning. Whether those cases were more complicated than the others cannot be assessed in our study as we do not have detailed patient data related to conditions other than CHF. We know from the GPs’ comments, however, that certain circumstances in the clinical situation could also be perceived as
limiting the usability of the CDSS (such as very old age or the presence of other severe conditions). We probably would have seen a stronger influence of the CDSS if we had restricted the evaluation to cases where the GPs themselves felt a need to use it. However, with such a design the data collection would have taken an unacceptably long time. For optimal effect in everyday clinical work, we believe it is advantageous to let the GP decide for themselves when to use the program. The fact that the CDSS did not allow a two-drug combination that was regularly used at this clinic turned out to be a drawback, according to the GPs’ comments.

The CHF cases

Age and gender distributions of the patients as well as the prevalence of the related conditions and the proportion of patients who underwent echocardiography were similar to those reported for Sweden in a large international survey on the management of CHF in primary care.32 The total usage of ACE inhibitors or angiotensin II receptor antagonists was also on the same level, but the usage of diuretics and betablockers was somewhat higher in our study.

Strengths

The main strength of this study is that the CDSS was tested on real-life patients by the GPs who were taking care of them – imitating real clinical situations. Each patient case was familiar to the GP who made the assessment with the support of the CDSS, thus constituting a revision of the GP’s previous judgement of the case.

The program itself was an advanced CDSS, not only translating clinical guidelines to patient-specific advice, but also providing descriptions of the rules in the guidelines and explanations for the suggestions, which has been shown to increase user acceptance.33 It also possessed three of the four most important features identified by a meta-analysis as being associated with improved clinical practice: provision of decision support at the time and location of decision making, provision of a recommendation rather than just an assessment and computer-based generation of decision support.34

Limitations

One limitation of the study is that we had a small sample of GPs, thereby restricting the possibilities for generalisation of the results. As we did not have any control group, we cannot with certainty differentiate the effect of the CDSS from the effect of the GPs simply reasoning about the management of their CHF cases a second time. It would also have been advantageous to have further data about the patients’ medical background, such as duration of the CHF and other comorbidities, in order to better illuminate the decision-making situation of the GPs. However, it was not possible to find reliable data regarding those factors. The only data we have are the NYHA classification of function, which gives a picture of the severity of the CHF, and some medical conditions of importance regarding the selection of medications (see Table 2).

Another limitation is that the cases already had a previously stated diagnosis and ongoing treatment. The diagnostic module was most useful when used in new cases and when the diagnostic investigations for CHF had been performed recently. When the investigations had been done further in the past or the patients were already using treatment for CHF, thereby diminishing the symptoms and signs, the program could have underestimated the presence of CHF. Patients with CHF were selected by searching the EPR, and this could also limit the possibility of attaining the maximal effect of the CDSS: other studies have shown that finding patients with CHF by searching the problem list of the EPR is most often not sufficiently reliable.35 Inclusion of the cases where the GP did not think of the possibility of CHF or felt too uncertain to record the diagnosis could have improved our results, as the CDSS could probably give most support in those cases.

Conclusions

The present CDSS influenced the GPs’ confidence in the diagnosis of CHF in every fourth case, their considerations about investigations in every third case and their considerations about medications in almost every fifth case. The perceived support from the use of the CDSS reported by the GPs could be described as substantial in one-third of the cases. Therefore, applying a CDSS based on evidence-based guidelines to the medical records of patients with CHF in primary care could have a significant influence on GPs’ disease management.

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22. EviBase. www.inlinedss.se/evibase/


CONFLICTS OF INTEREST

None.

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