Quality of congestive heart failure care

Assessing measurement of care using electronic medical records

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ABSTRACT

OBJECTIVE To study the feasibility of using electronic medical record (EMR) data from the Deliver Primary Healthcare Information (DELPHI) database to measure quality of care for patients with congestive heart failure (CHF) in primary care and to determine the percentage of patients with CHF receiving the recommended care.

DESIGN Items listed on the Ontario Ministry of Health and Long-Term Care Heart Failure Patient Care Flow Sheet (CHF flow sheet) were assessed and measured using EMRs of patients diagnosed with CHF between October 1, 2005, and September 30, 2008.

SETTING Ten primary health care practices in southwestern Ontario.

PARTICIPANTS Four hundred eighty-eight patients who were considered to have CHF because at least 1 of the following was indicated in their EMRs: an International Classification of Diseases billing code for CHF (category 428), an International Classification of Primary Care diagnosis code for heart failure (ie, K77), or "CHF" reported on the problem list.

MAIN OUTCOME MEASURES Number of CHF flow sheet items that were measurable using EMR data from the DELPHI database. Percentage of patients with CHF receiving required quality-of-care items since the date of diagnosis.

RESULTS The DELPHI database contained information on 60 (65.9%) of the 91 items identified using the CHF flow sheet. The recommended tests and procedures were recorded infrequently: 55.5% of patients with CHF had chest radiographs; 32.6% had electrocardiograms; 32.2% had echocardiograms; 30.5% were prescribed angiotensin-converting enzyme inhibitors; 20.9% were prescribed β-blockers; and 15.8% were prescribed angiotensin II receptor blockers.

CONCLUSION Low frequencies of recommended care items for patients with CHF were recorded in the EMR. Physicians explained that CHF care was documented in areas of the EMR that contained patient identifiers, such as the encounter notes, and was therefore not part of the DELPHI database. Extractable information from the EMR does not provide a complete picture of the quality of care provided to patients with CHF.

EDITOR'S KEY POINTS

- Electronic medical records (EMRs) are an important potential data source for both monitoring and improving care for congestive heart failure (CHF) by FPs.
- The goal of this study was to determine whether items relating to CHF care could be measured using EMRs.
- Much of the information on CHF care is not accessible for measurement in the searchable portion of EMRs, compromising complete evaluation of the quality of CHF care.

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Qualité des soins pour l'insuffisance cardiaque congestive

Évaluation des soins à l'aide des dossiers médicaux électroniques

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RÉSUMÉ

OBJECTIF Déterminer si on peut utiliser les données des dossiers médicaux informatisés (DMI) provenant de la base de données Deliver Primary Healthcare Information (DELPHI) pour mesurer la qualité du traitement de l'insuffisance cardiaque congestive (ICC) en médecine de première ligne et déterminer quel pourcentage des patients souffrant d'ICC reçoivent les soins recommandés.

TYPE D'ÉTUDE On a évalué et mesuré les items énumérés dans l'organigramme du ministère de la Santé et des Soins de longue durée de l'Ontario pour les patients souffrant d'ICC à l'aide des DMI des patients ayant eu un diagnostic d'ICC entre le 1er octobre 2005 et le 30 septembre 2008.

CONTEXTE Dix cliniques de soins de santé primaires du sud-ouest de l'Ontario.

PARTICIPANTS Un total de 488 patients qu'on a jugés porteurs d'ICC parce qu'au moins un des éléments suivants était indiqué dans leur DMI : un code de facturation pour ICC de la Classification internationale des maladies (catégorie 428), un code de diagnostic pour insuffisance cardiaque de la Classification internationale des soins primaires (c.-à-d. K77), ou une « ICC » mentionnée dans la liste des problèmes.

PRINCIPAUX PARAMÈTRS ÉTUDIÉS Nombre d'items de l'organigramme de l'ICC qu'on pouvait mesurer à partir des données des DMI tirés de la base de données DELPHI. Pourcentage des patients souffrant d'ICC qui recevaient les éléments requis pour des soins de qualité depuis la date du diagnostic.

RÉSULTATS La base de données DELPHI contenait de l'information sur 60 (65,9%) des 91 items identifiés à l'aide de l'organigramme de l'ICC. Les examens et interventions recommandés étaient peu souvent enregistrés 55,5% des patients avaient eu des radiographies thoraciques; 32,6%, des électrocardiogrammes; 32,2%, des échocardiogrammes; 30,5%, des prescriptions d'inhibiteurs de l'enzyme de conversion de l'angiotensine; 20,9%, des prescriptions de bêta-bloqueurs; et 15,8%, des prescriptions de bloqueurs des récepteurs de l'angiotensine II.

CONCLUSION Les items concernant les soins recommandés pour l'ICC étaient peu souvent inscrits dans les DMI. Les médecins ont expliqué que le traitement de l'ICC était consigné dans des sections du DMI comportant des éléments identifiant les patients, comme les notes des rencontres, de sorte qu'il ne faisait pas partie de la base de données DELPHI. L'information qu'on peut obtenir des DMI ne fournit pas une image complète de la qualité des soins donnés aux patients souffrant d'ICC.

POINTS DE REPÈRE DU RÉDACTEUR

- Les dossiers médicaux informatisés (DMI) représentent une importante source éventuelle de données pour le monitorage et l'amélioration du traitement par le MF de l'insuffisance cardiaque congestive (ICC).
- Cette étude avait pour but de déterminer si on peut mesurer les éléments liés au traitement de l'ICC à l'aide des DMI.
- Une partie importante de l'information sur le traitement de l'ICC n'est pas mesurable dans la partie accessible des DMI, ce qui compromet l'évaluation complète de la qualité du traitement.

Cet article a fait l'objet d'une révision par des pairs.
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Congestive heart failure (CHF) is a costly health condition to both the patient and the health care system[1]; therefore, assessing and optimizing CHF care is an important goal. Electronic medical records (EMRs) are an important potential data source for research on primary care.

To improve chronic disease management in primary care, the Ontario Ministry of Health and Long-Term Care (MOHLTC) initiated a Heart Failure Management Incentive in April 2008, which provides $125 per patient to the physician for completing the required elements of care listed on the Heart Failure Patient Care Flow Sheet (CHF flow sheet).[2] The elements of management of patients with CHF listed on the CHF flow sheet are based on the Canadian Cardiovascular Society's consensus guidelines on the diagnosis and management of heart failure[3,4] and provide a list of items that could be used to measure quality of patient care.

The objective of this study was to evaluate the potential measurement of elements of quality of CHF care listed on the CHF flow sheet, using routinely collected EMR data from the Deliver Primary Healthcare Information (DELPHI) database in southwestern Ontario. A secondary objective was to measure the percentage of patients receiving the recommended quality-of-care items. This was a feasibility study to determine whether we could use the EMR to measure items related to CHF quality of care. The results were not intended to be a quantitative analysis evaluating the quality of care provided by physicians.

To the best of our knowledge, this is the first study evaluating the ability to measure Canadian guidelines for management of CHF in primary care using the EMRs in the DELPHI database.

METHODS

The DELPHI database is located at the Centre for Studies in Family Medicine at the University of Western Ontario in London. This research database contains de-identified EMR data from 10 primary care practices in southwestern Ontario. All practices use one common EMR software. To protect patient privacy, the DELPHI database does not contain information from the encounter notes or scanned image attachments that contain patient names. The DELPHI project received approval from the University of Western Ontario Review Board for Health Sciences Research Involving Human Subjects.

Patient data were extracted from the DELPHI database for a 3-year period, between October 1, 2005, and September 30, 2008. Patients for this study were considered to have CHF if 1 of the following was indicated in their EMRs: an International Classification of Diseases (ICD-9) billing code for CHF (category 428); an International Classification of Primary Care (ICPC-2-R) diagnosis code for heart failure (ie, K77); or "CHF" on the patient's problem list (free text or ICD-9). Of the 30 151 patients in the database, 488 patients with CHF were identified. For the purposes of this study, the patient's date of diagnosis was identified as the first time he or she had an indication of CHF in the EMR. Patients' EMR data were assessed from the date of diagnosis to determine whether they received care items recommended on the CHF flow sheet. Elements of recommended care identified on the CHF flow sheet were assessed using a 3-step process. First, items were discussed with FPs on the DELPHI team to determine how they should be defined and how they should be documented in patients' EMRs. Second, items were assessed for their ability to be quantified and measured as having occurred using the EMR. Lastly, items were assessed for their ability to be measured using the EMR data in the DELPHI database.

A total of 103 items representing elements of CHF care were identified using the CHF flow sheet; 91 of these were considered for inclusion in our study. Twelve items from the patient self-management recommendations section were not considered because they pertained to discussions physicians had with patients about self-management, and these were not measurable using patients' primary care records.

Of the 91 items that were identified, 60 (65.9%) could be measured and were available within the DELPHI database (**Table 1**). Thirty-one items from the following sections could not be used: 2 items from diagnosis, which required identification of patients with either systolic heart failure or heart failure with preserved systolic function; 3 items from initial investigations to assist diagnosis; 6 items from physical examinations; and 12 items of exclusionary criteria for accurate assessment of pharmacologic management for systolic heart failure. Information to measure the above items was found in the encounter notes and the specialist

Table 1. Items in the Ontario MOHLTC CHF flow sheet[2] that are available in the DELPHI database

SECTIONS ON THE CHF FLOW SHEET	NO. OF ITEMS THAT COULD BE MEASURED (N = 91)	NO. OF ITEMS AVAILABLE IN THE DELPHI DATABASE (N = 60)
Diagnosis	4	2
Initial investigations to assist diagnosis	22	19
Vaccinations	2	2
Required elements of care:		
• Physical examinations	22	16
• Laboratory tests	8	8
• Patient self-management	5	5
Pharmacologic management for systolic heart failure	28	8

CHF—congestive heart failure, DELPHI—Deliver Primary Healthcare Information, MOHLTC—Ministry of Health and Long-Term Care.

or hospital reports, and it was not collected as part of the DELPHI database in order to protect patient privacy. Eight additional items from the pharmacologic management for systolic heart failure section were not used because they were related to adequacy of prescription dosage and were specific to each patient, and thus not measurable as process indicators of quality of care.

Of the 60 items that could be measured and that were available in the DELPHI database, 20 key items selected by the clinician authors were measured for the purposes of this study. Forty remaining items were not measured for the following reasons: 1) they were outcome indicators of quality of care, such as laboratory test results, 2) they were focused on diagnosis of the patient and were not process indicators of quality of care after diagnosis, or 3) the data were only available for a small subset of patients who were coded with ICPC-2-R symptom and diagnosis codes.

For the 20 items measured in this study, patients were coded as having received the recommended patient care item if they had an indication of the examination or treatment at least once since their date of diagnosis. The EMR data were examined before the date of diagnosis only for the chest radiograph, electrocardiogram, or echocardiogram tests, as these were in the initial investigations to assist diagnosis section of the flow sheet. Descriptive data analysis was performed using SPSS 17.0.

RESULTS

Of the 488 patients identified with CHF, a low percentage received each of the 20 recommended patient care items (**Table 2**). The percentage of patients with echocardiograms, electrocardiograms, or chest radiographs ranged between 32.2% and 55.5%. Laboratory testing ranged from 66.4% to 72.5%, leaving more than 25% of patients without the recommended laboratory tests recorded in their EMRs. Nonetheless, more than 78.1% of patients had at least 1 blood pressure measurement since their date of diagnosis. The percentage of patients with prescriptions for angiotensin-converting enzyme inhibitors (ACEIs) was 30.5%; 15.8% were prescribed angiotensin II receptor blockers (ARBs); and 20.9% were prescribed β-blockers.

Table 2. Patients with CHF (N = 488) receiving quality-of-care item at least once since the date of diagnosis

QUALITY-OF-CARE ITEMS, BY CHF FLOW CHART[2] SECTION	PATIENTS WITH CHF WHO HAD THIS ITEM RECORDED, N (%)
Initial investigations to assist diagnosis	
• Chest radiograph	271 (55.5)
• Electrocardiogram	159 (32.6)
• Echocardiogram	157 (32.2)
Vaccinations	
• Annual influenza vaccine	206 (42.2)
• Pneumococcal vaccine	87 (17.8)
Physical examinations	
• Blood pressure	381 (78.1)
• Weight	200 (41.0)
• Heart rate	137 (28.1)
Laboratory tests	
• Serum creatinine	354 (72.5)
• Potassium	340 (69.7)
• Sodium	337 (69.1)
• eGFR	324 (66.4)
Medications	
• Loop diuretic	224 (45.9)
• Angiotensin-converting enzyme inhibitor	149 (30.5)
• Anticoagulant	118 (24.2)
• β-Blocker	102 (20.9)
• Angiotensin receptor blocker	77 (15.8)
• Acetylsalicylic acid	58 (11.9)
• Digoxin	55 (11.3)
• Spironolactone	28 (5.7)

CHF—congestive heart failure, eGFR—estimated glomerular filtration rate.

DISCUSSION

Compared with the findings of other studies, a low percentage of CHF patients in the DELPHI database were identified as receiving the recommended CHF care. For example, the rate of echocardiogram testing was low compared with a study that found 52.0% of patients hospitalized for CHF had echocardiograms before or during admission to hospital in Ontario.[5]

In addition, 31.6% of CHF patients in the DELPHI database were prescribed either ACEIs or ARBs since their date of diagnosis—a percentage that is much lower than in other studies. For example, 82.0% of patients hospitalized for CHF were prescribed ACEIs by the time they were discharged from hospital.[5] In a nonrepresentative sample of 137 primary care practices in Ontario, 93% of patients with CHF were found to have been prescribed ACEIs or ARBs in the previous 2 years.[6]

Various factors might account for the low percentage of patients identified as receiving the recommended CHF care in the DELPHI database: physicians were not providing care according to the guidelines; physicians were not documenting the care provided to patients; or the care provided could not be measured using the EMR data in the DELPHI database.

Our impression is that FPs were providing CHF care according to the guidelines, and some were using the CHF flow sheet to obtain the MOHLTC incentive for care of patients with CHF. However, another interpretation

could be that divergent opinions existed about the need for particular items listed on the CHF flow sheet, including diagnostic and follow-up echocardiograms. First, we believe that attention to the details of the CHF flow sheet was perceived by FPs as making only marginal differences in patient outcomes and did not change the management of heart failure in their practices, thus affecting documentation; for example, some FPs explained that the recommended items on the flow sheet did not make a difference to the length of life for patients with CHF. Second, we believe that the main reason for the low percentage of echocardiograms, prescriptions, and other recommended CHF care items was the way these items were documented in the patient records. These CHF care items were documented in parts of the EMR that were not extracted in order to protect patient identity, including the encounter notes section, hard-copy flow sheets, and documents kept in paper charts, as well as hospital or specialist reports, which were scanned and attached as image files to the EMR.

Many of the items listed on the MOHLTC CHF flow sheet (65.9%) were easily obtained from the EMR. Before EMRs become more prevalent and used for measuring quality of care, we need to understand their strengths and limitations. Data located in the structured portions of the EMR are more readily accessible for measurement of quality-of-care indicators. However, indicators of quality of care for CHF need to encompass all aspects of patient care, including those that are not readily accessible from these standardized portions of the EMR, such as the free-text encounter notes or scanned image files containing hospital and specialist reports. The use of new technological software for the extraction of quality-related information from the encounter notes section of the EMR without revealing personal identifiers is under way.[7] The use of encounter notes and the ability to view scanned image files without patient identifiers will greatly improve the ability to measure quality of CHF care in primary care.

Limitations

The limitations of this study included incomplete patient records, inaccessibility of data from some portions of the EMR, and the inability to identify patients with valid exclusionary criteria. These limitations affected the ability to accurately estimate the percentage of patients receiving the recommended CHF quality-of-care items.

The EMR data used in this study only contained patients' primary care records for the 3 years of data collected. It was not possible to determine the date of diagnosis for each patient and identify the patients who were diagnosed before the start of the study to exclude them from the analysis. Patients who were diagnosed before the start of the study might have already received many of the initial investigations to assist in diagnosis, laboratory tests, and prescriptions. As a result, a number of patients might have appeared to not be receiving the recommended CHF care. In addition, patients were only required to have had 1 indication of a procedure, laboratory test, or prescription. Ideally, we would follow patients prospectively from their date of diagnosis and assess the provision of care over time, which might require more than 1 indication of each patient care item since diagnosis.

To protect patient identity, the data extracted from the EMR does not include items that would contain patient identifiers. These include the encounter notes section of the EMR and specialist reports that are stored in the form of image files attached to the EMR. Specialist reports might also be stored as paper records in physicians' offices, and these reports are not entered into the fields of the EMR that are extracted for research. As a consequence, CHF care received in hospital or by a specialist was not documented in the researchable portions of the EMR.

Laboratory testing performed during the 3 years of the study was expected to be a part of the EMR. Most of the laboratory test data were automatically downloaded from the testing centre to physicians' practices and appeared in patients' records. However, when patients attended a testing centre that did not provide automatic download of their results, it was unlikely that their results were manually entered into the EMR to allow measurement of associated indicators. Agnew-Blais et al encountered a similar problem in their study, in which 15% of their patients were found to be having laboratory testing done off-site, and the results were not automatically uploaded to their EMRs at the practices, reducing the percentage of patients found to have received the recommended patient care.[8] Patients might also be noncompliant for tests ordered by their physicians.

When considering appropriate use of medications for systolic heart failure or heart failure with preserved systolic function, patient intolerance and contraindications need to be considered. The EMRs used in this study do not provide information to identify patients with these valid exclusionary criteria. As a consequence, we were unable to quantify the number of patients meeting the exclusionary criteria for recommended medications, which could affect frequencies of quality-of-care indicators and reduce the percentage of patients who appeared to be receiving appropriate patient care.

Future research could use another type of EMR software to examine the accessibility of items on the CHF flow sheet, the percentage of patients receiving the recommended patient care, and the reliability of EMR data compared with manual chart audits.

Conclusion

More than 60% of the MOHLTC CHF flow sheet guidelines for CHF care in primary practice could be measured using the EMR data in the DELPHI database. The rates of CHF patients receiving the recommended MOHLTC

CHF flow sheet items were low, and ranged from 5.7% to 78.1%. Limitations included the inability to obtain a complete primary care record for each patient, as data were only extracted for the 3 years used in the study. Many of the CHF flow sheet items that were expected to be accessible in the structured fields of the EMR were actually recorded in the encounter notes section or in the scanned image files documenting the hospital and specialist reports that contained patient identifiers, and therefore were not accessible for inclusion in the DELPHI database to protect patient privacy. As a result, much of the information on CHF care is not accessible for measurement in the searchable portions of the EMR of the DELPHI database, compromising complete evaluation of the quality of CHF care.

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Contributors

Ms Maddocks conducted analysis of the data and was first author of the manuscript. **Dr Marshall** assisted in the design and analysis of the data, and contributed substantially to the writing of the manuscript. **Dr Stewart** directed the research to be conducted, oversaw the data analysis, interpreted results, and edited the manuscript. **Dr Terry** contributed to the design and analysis of the data, and edited the manuscript. **Dr Cejic** assisted in the design and analysis, as well as interpretation of results, and edited the manuscript. **Drs Hammond** and **Jordan** interpreted the results and contributed substantially to the information contained in the discussion section. **Ms Chevendra** contributed to the design, data analysis, interpretation of results, and editing of the manuscript. **Ms Bestard Denomme** collected the data from the practices, interpreted results, and edited the manuscript. **Dr Thind** contributed to the design and analysis of the data, and edited the manuscript.

Competing interests

None declared

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