

**Title: Utility of Electronic Medical Records in Community Rheumatology Practice for  
Assessing Quality of Care Indicators for Gout: A Feasibility Study**

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## **ABSTRACT**

### **Objectives**

With comprehensive capture of information on patient encounters, electronic medical records (EMRs) may have utility for assessing adherence to quality indicators (QI) in gout. Our objectives were to translate 10 previously established gout QIs into relevant EMR data and evaluate and describe the feasibility of using EMRs to assess gout QIs.

### **Methods**

Using EMRs from three community rheumatology practices in Vancouver, British Columbia, Canada, we identified gout patients seen between January 01, 2012 and December 31, 2013. We translated each gout QI into potential EMR variables that would allow identification of patients the QI pertains to and whether the QI could be assessed. We extracted deidentified EMR data on gout diagnosis, medications, laboratory tests, radiologic tests, and clinical notes and calculated the percent availability of data for each QI.

### **Results**

We included 125 patients with gout, with mean age  $64 \pm 17$  years and with males comprising 78%. Overall, there were sufficient EMR data to allow translation of seven QIs and assessment of six QIs including therapy-related gout QIs (69% to 83% data availability) and one counselling-related QI (8% data availability). The highest percent data availability was observed in the single QI translated into EMR data and assessed based on diagnostic codes and prescription medications and not laboratory tests.

### **Conclusions**

EMRs are promising tools for assessing QIs for gout. With increased use of EMRs by physicians, our study has implications for informing processes for their enhanced use to improve patient care and outcomes in gout.

## **BACKGROUND**

Gout is an excruciatingly painful inflammatory arthritis that affects up to 3.8% of adults[1], and is complicated by substantial cardiovascular, metabolic, and renal comorbidities[2]. In accordance with managing the disease burden of gout, ten quality indicators (QIs) addressing use of therapies and counselling on lifestyle modification have been developed and validated[3]. Clinician adherence to these QIs has been assessed using administrative data, however inherent data deficiencies limited assessment to  $\leq 3$  of the 10 QIs[4,5].

Studies have shown the utility of electronic medical records (EMRs) for assessing clinician performance and identifying areas for practice improvement in chronic conditions including cardiovascular disease[6], hypertension[7], and diabetes[8]. Recently, natural language processing and mining were applied to narrative and coded data, respectively, in a medical centre EMR to assess clinician adherence to the gout QI on lifestyle modification counselling as well as three therapy-related QIs[9]. These promising data suggest a potential role of EMRs in the assessment of gout QIs, particularly in community practices where most patients are seen. As a first step towards evaluating this role, we conducted a feasibility study with the objectives of: 1) translating gout QIs into relevant EMR data; and 2) evaluating and describing the feasibility of using EMR data to assess gout QIs.

## **METHODS**

### **Study Cohort and Data Source**

We conducted a feasibility study nested within a longitudinal study of an electronic health (eHealth)-supported collaborative care model involving rheumatology, pharmacy, and dietetics for patients with

gout. We identified a cohort of gout patients seen at three academic community rheumatology practices affiliated with the University of British Columbia in Vancouver, British Columbia, between January 01, 2012 and December 31, 2013. Specifically, patients with gout were those who received any of the following *International Classification of Diseases, Ninth Revision (ICD-9)* codes for gout (274, 274.01, 274.02, 274.8, 274.89, 274.9), tophaceous gout (274.03, 274.81, 274.82), and uric acid nephrolithiasis (274.11) in Plexia Electronic Medical Systems ([www.plexia.ca](http://www.plexia.ca)), a British Columbia-based system that is used by more than half of the rheumatologists in the province. This EMR captures information from patient care episodes across the following fields in the physician-user interface: 1) Patient Profile which includes Demographic Information (sex, date of birth), Medical Problems (ICD-9 coded medical conditions), and Prescriptions where prescription and non-prescription medications containing a drug identification number are entered including order date, total quantity, dose, directions for use, and duration; 2) PathNet, where laboratory tests, including test date, collected time, value, and units are electronically received; 3) Files, where scanned documents, including reports (e.g., radiology) are uploaded; and 4) Notes, the narrative portion of the EMR.

### **Translating Gout Quality Indicators into EMR Data**

Gout QIs are evidence-based process indicators pertaining to gout care. Mikuls et al [3]. developed and validated 10 QIs for gout. Nine involve use of medications including urate-lowering therapies (ULT) and anti-inflammatory therapies and one involves provision of counselling on lifestyle modifications. Each QI is a conditional statement[10] with a two-part “IF” component referring to **1)** patients the QI pertains (e.g., QI 1, gout patients receiving allopurinol) to *and* **2)** clinical characteristics that determine eligibility for the QI (e.g., QI 1, having significant renal impairment) and a “THEN” component referring to the care process to be provided[3]. Given the myriad of patient data captured

in the EMR, complete data extraction and mining to derive gout QIs is inefficient. Thus, we applied a process of translating each QI into all potential EMR variables representing QI statement components. A research pharmacist (AE) constructed a master list specifying EMR variables, corresponding EMR field(s), and all relevant elements (**Supplementary Table <http://links.lww.com/RHU/A80>**). In some instances, specifying a variable and corresponding entry date is sufficient, for example an ICD-9 code representing gout (e.g., 274) and corresponding entry date to define ‘gout’; however, there were also instances that required specification of the variable and relevant date and units (e.g., serum creatinine [SCR] or creatinine clearance rate [CRCL] to define ‘renal impairment’). For the Patient Profile and PathNet fields of the EMR, extraction of EMR variables specified in the master list was customized and executed by Plexia and data were exported into Microsoft Excel to generate a database with patient-level episodes of care (i.e., visit to rheumatologist, a lab report). We used a custom-built Microsoft Excel query to analyze these data. Text entries in the Files (uploaded documents and reports) and Notes fields (narrative portion) were also downloaded into a Microsoft Excel database. However, due to the text-based nature, we used keyword searches to identify relevant elements – for example “drink”, “beer”, “wine” to identify alcohol use, which pertains to QI 8 (Supplementary Table <http://links.lww.com/RHU/A80>).

### **Feasibility of EMR for Assessing Gout Quality Indicators**

For each gout QI, we defined feasibility as the availability of translated EMR data with respect to the number of patients in study cohort the QI pertains to (denominator) and the number of patients with clinical data to assess eligibility for the QI (numerator) (**Figure 1**). As such, we calculated % availability of translated EMR data to provide a measure of the feasibility of the EMR for assessing gout QIs.

Ethics approval was obtained for this study from the University of British Columbia Clinical Research Ethics Board (H15-01511).

## RESULTS

125 patients with gout were identified during the period of study and all were included. The mean age was  $64 \pm 17$  years and 78% were male. Demographic and clinical characteristics are summarized in **Table 1**.

From the EMR, we extracted data representing 1,413 episodes of care across both Patient Profile and PathNet fields, 230 text entries from the Files field, and 936 text entries from the Notes field. In translating gout QIs into EMR data, the number of potential EMR variables identified ranged from 20 (QI 9) to 39 (QI 3) variables (**Table 2, Supplementary Table** <http://links.lww.com/RHU/A80>). Altogether, it was feasible to translate seven of the 10 gout QIs (QIs 1, 2, 3, 5, 7, 8 and 10) into relevant EMR variables and feasible to assess six with our study cohort. Five of the QIs that we could assess (QIs 1, 3, 5, 7, and 10) represented processes of medication use (ULT or anti-inflammatory agents) among gout patients, with % availabilities ranging from 69% to 83%. The highest % data availability was observed for QI 7 - the single QI translated based on diagnostic codes and prescription medications and not laboratory tests. It was also feasible to assess QI 8, which pertained to providing counselling on lifestyle modifications for gout patients with obesity or frequent alcohol use. However, % data availability was only 8% and driven by the low number of gout patients with available EMR data to assess eligibility for this QI. Although it was feasible to translate QI 2 into EMR data, we could not assess it as there were no representative patients in the study cohort to which this QI pertained



to, that is gout patients receiving a xanthine oxidase inhibitor in the setting of co-therapy with azathioprine or 6-mercaptopurine - as there were no representative patients in the study cohort.

It was not feasible to translate and assess three of the ten QIs (QIs 4, 6, and 9). In two of these, limitations were largely due to the fact that pertinent patients were those with hyperuricemia (QIs 4 and 6) and we were limited to creating our cohort to those with gout. While we identified EMR variables to translate two of the three clinical characteristics for eligibility for QI 4 (e.g., ICD-9 variables representing “gouty arthritis and tophaceous gout” or “nephrolithiasis and hyperuricosuria”), we could not translate “treatment of malignancy” as this potentially spans pharmacological, radiation, and surgical interventions, which may not be captured in rheumatologists’ EMRs. For QI 6, despite the ability to translate “tophaceous gout” from coded data in Patient Profile interface as well as “gouty erosive changes on radiographs” by applying text search functions to radiology reports in the Files interface, “gout attacks” are not well captured in the EMR. Finally, QI 9 pertained to patients with “acute gouty arthritis” for which there is lack of specific ICD-9 codes. Furthermore, prior methods of identifying gout flares in databases have used combinations of ICD-9 codes for gout and anti-inflammatory agents[11], which essentially comprise the QI care process.

## **DISCUSSION**

To our knowledge, this is the first study to evaluate the feasibility of translating community rheumatology EMR data into gout QIs and their availability for assessing gout QIs. It was feasible to

translate seven gout QIs into relevant EMR variables and there was sufficient EMR data to feasibly assess six of these QIs – five pertaining to use of therapies with % availability ranging from 69% to 83% and one pertaining to counselling on lifestyle modification with only 8% data availability. These findings lend evidence to support the utility of EMRs for gout QI assessment, with implications for helping improve management of this disease.

In comparing this current study with prior studies of adherence to gout QIs, which largely used administrative data, we found a greater number of QIs assessed with EMRs (**Table 2**). Using data in the UK General Practice Research Database (GPRD) Mikuls et al. were able to assess QIs 1, 2, and 3[4]. Furthermore, because laboratory data were not uniformly available, diagnostic codes were used (e.g., to define “asymptomatic hyperuricemia” and “renal impairment”) which may be vulnerable to misclassification[3]. In Singh et al.’s study, data limitations in US Veterans’ Affairs (VA) databases, including lack of radiographic data, information on non-prescription NSAIDs, and details of diagnoses other than gout, also precluded assessment to three therapy-related QIs, namely QIs 1, 7, and 10[5] (**Table 2**). Kerr et al. similarly used US VA databases and were able to assess the same three QIs as well as QI 8 on life style modifications[9].

Indeed, despite the availability of evidence-based information, including QIs to guide care, management of gout remains sub-optimal[12]. Prior aforementioned studies reporting poor clinician adherence to gout QIs[4,5] not only contribute evidence to management issues in gout, but may also suggest the low uptake or knowledge of these QIs by clinicians. In continued calls to improve quality of care for gout, recommendations include greater education about evidence-based information regarding gout and its care, including guidelines and QIs[12]. By demonstrating the feasibility of EMRs for assessing gout QIs, our study has practical implications for incorporating QIs into a clinician’s practice, beyond assessment of adherence. For example, EMRs may be used to flag

pertinent gout patients eligible for a care process specified by a QI to ensure that the appropriate care is provided.

Our findings suggest that EMRs are feasible and promising tools for assessing QIs for gout and are timely and relevant given the growing popularity of EMRs - used by nearly 75% of Canadian physicians, according to the 2014 National Physician Survey[13]. Along with this increased use are questions on how advanced uses of EMRs, beyond capturing information on encounters of care, can improve patient outcomes[14,15]. Given its retrospective nature, our evaluation and description of the feasibility of EMRs for assessing QIs for gout was set in the context of routine care, with no treatment algorithms or guidelines imposed on participating rheumatologists. Indeed, real-world feasibility studies such as ours are important in terms of outlining an efficient mechanism for harnessing EMR functions and providing evidence of feasible processes for doing so.

Nonetheless, limitations of our study warrant discussion. As this feasibility study was nested within a larger prospective study on eHealth-supported collaborative care for gout, we were limited to creating our cohort on patients with gout (as defined by ICD-9 codes). As such, it was not feasible to assess two QIs (QI 4, QI 6) as pertinent patients were those with hyperuricemia. However, with both QIs, we additionally identified limitations in available EMR data for translating some of the clinical characteristics that determine eligibility for the QI. As such, even with inclusion of hyperuricemia patients, limitations precluding feasibility may persist. Our study was conducted using a single EMR system, which is available only to rheumatologists based in British Columbia, and translation of gout QIs into variables may not be directly generalizable to other platforms. However, by establishing a process of translating gout QIs into EMR data and evaluating feasibility of QI assessment, there is potential for replication of our study using other platforms. Finally, as this was a feasibility study of translating gout QIs into EMR data and availability for allowing QI assessment, we did not assess

rheumatologists' adherence to QIs themselves. Nonetheless, **Figure 1** provides an illustration of how we have defined and measured the feasibility of EMR for assessing QIs while also showing the distinction from assessing adherence to QIs. Indeed, the latter was beyond the scope of our study. Furthermore, with only three practices included in the feasibility study, assessment of adherence to QIs does not constitute a meaningful research question in the context of existing evidence on adherence to QIs in a large institution such as the VA[5] or defined geographic area such as that covered by the UK GPRD[4].

Finally, potential implications of our study deserve comment. Short-term implications include recommendations for clinicians, particularly rheumatologists, to ensure completeness of data entry for QI assessment. These could certainly be facilitated by EMR providers through the development and implementation of gout templates reflecting the 10 QIs within EMRs or alert functions to remind rheumatologists to enter pertinent information, for example information on drinking habits, obesity, and lifestyle counselling. Beyond these, this study has long-term implications for informing further research on taking advantage of EMRs to incorporate QIs into clinicians' practice to help improve gout management. Overall, we showed that EMRs are feasible and promising tools for translating and assessing QIs for gout.

## **KEY POINTS**

- Electronic Medical Records are a feasible tool in assessing QIs for gout.

- Gout QIs that were most amenable to translation and assessment with EMR data were those representing processes of medication use.
- Limitations for implementation include completeness and availability of EMR data.

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## FIGURE LEGEND

**Figure 1.** Graphical representation of the evaluation of the feasibility of EMR for assessing quality indicators for gout (current study) shown in contrast to assessing adherence to quality indicators for gout.