Examining the Impact of Regular Physician Visits on Heart Failure Patients: a Use Case with Electronic Health Data

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Abstract

The rapid adoption of electronic health records (EHRs) presents opportunities to study care management within health systems. We examine the efficacy of using EHR data to assess the outcomes of outpatient care for chronic disease management. A retrospective-prospective study was conducted using 6 years of archived EHR data from patients treated for heart failure at a rural community hospital. Patients were placed into two cohorts, 'Regular' and 'Non-Regular', based on the frequency of provider contact. A hospital charge ratio was used to calculate cost. Patient mortality and the frequency of unintended events were used to assess patient outcomes. Case study results suggest that sporadic outpatient care was associated with greater utilization of more intensive health-care services. When inpatient and Emergency Department utilization became necessary for both groups, the Regular outpatient cohort had lower mortality rates, fewer read-missions, and incurred lower and less variable costs. Overall, the study showed great potential for using EHR data for assessing care outcomes, notwithstanding some key limitations. We conclude by discussing the types of insights possible and shortcomings attributed from health systems research derived from EHR data.

Keywords:

Electronic health records; Heart failure; Cost of care; Healthcare utilization

INTRODUCTION

Research on health services and policy issues requires access to complete, accurate, and timely patient and organizational data. However, in the United States, health-related data sets are created and held by diverse, public and private organizations and individual researchers (Bradley et al, 2010). To overcome incomplete data from a single source, skilled researchers take months or years to acquire, link, and extract meaningful information from a myriad of sources (Bradley et al, 2010). To offset such data segmentation, the federal government has incentivized health systems to implement electronic health records (EHRs) and subsequently use these records for health systems research (U.S. Department of Health and Human Services, 2013). Under the federal 'meaningful use' guidelines, health systems are incentivized to use electronic data to improve clinical and population health outcomes, improve transparency and efficiency, empower individuals to make better decisions, and provide more robust research data on health systems (U.S. Department of Health and Human Services, 2013). These incentives have already increased the quantity of clinical (Charles et al, 2013; Bates et al, 2014) and administrative data electronically available and, as intended, have created opportunities to use this data for health systems research.

This paper presents a use case of an opportunity to use EHR data to examine the efficacy of regular outpatient care for chronic disease management in a rural health setting. We deliberately restricted our data to those avail-able in the hospital's EHR. We examine heart failure (HF) patients because of the high prevalence and societal burden associated with this disease, and because it has been central to most population health projects sponsored by the Centre for Medicare and Medicaid Services. HF is one of the most common causes of hospitalization for people 65 years of age and older (Miller & Missov, 2001; Norton et al, 2011). The cost of managing HF is estimated to consume at least 1–2% of all health-care expenditures in developed countries (Bui et al, 2010). Two-thirds of all HF expenditures are hospitalizations (Lee et al, 2004), which are frequent (Cline et al, 1998; Blue et al, 2001) and partly preventable (Michalsen et al, 1998). The prognosis for HF is poor with high readmission and mortality rates (Shah & Gheorghiade, 2008; Bui et al, 2010; Lloyd-Jones et al, 2010).

The rural hospital setting demonstrates the potential for such hospitals to benefit from conducting health systems research from their own EHR data. These hospitals are not associated with large, urban, academic medical centers and most lack the large research and data infrastructures associated with such institutions. Yet, there are almost 3000 non-governmental community hospitals in the United States serving 17% of the population – nearly 54 million patients (American Hospital Association, 2012). Rural populations are typically older than most urban areas and Medicare margins are lowest for rural hospitals (American Hospital Association, 2012). As there are few care options available, the rural patient population represents a fairly complete patient history compared to patients in urban areas, providing an exemplary setting for analysis.

We first examine the role of preventive care in chronic disease management and define regular care using data from the hospital's EHR. We then present the results of the use case. We discuss the impact of regular care on the study population's medical outcomes and the financial impact of these activities. The paper concludes with a discussion of our experiences using EHR data for care management analysis of HF patients.

STUDY CONTEXT: DOES PREVENTIVE CARE WORK?

The potential of preventive care for ambulatory care-sensitive conditions is of particular interest for advocates of health-care reform. Proactive outpatient management of chronic conditions is a key component of the Affordable Care Act and associated proposals, which endeavour to achieve the 'triple aim' in health care – improve care, improve health, and reduce costs (Abrams et al, 2011; Dower & O'Neil, 2011; Nielsen et al, 2012). Outpatient management is intended to mitigate more severe problems from developing (Ferrante et al, 2000; Gadomski & Jenkins, 2001). Patients who regularly attend preventive care visits have fewer preventable Emergency Department (ED) encounters and hospital admissions than those who do not (Parchman & Culler, 1994; Bindman et al, 1995). Some primary care providers are able to manage chronically ill patients with fewer diagnostic tests and interventions, lower costs, and by protecting patients from what has been termed 'overtreatment' (Schoen et al, 2007).

A second growing body of literature has questioned the reported benefits of (regular) preventive care (Cohen et al, 2008). A review of 14 randomized trials found that general health check-ups for

healthy people have little effect on morbidity, hospital admission rates, disability, anxiety, or other physician or specialist visits (Krogsbøll et al, 2012; Joy, 2013; Regard, 2013). In a nationally representative sample, higher patient satisfaction (which can correlate with regular access) was associated with greater inpatient use, higher overall health-care expenditures, and increased mortality, but with less ED use (Fenton et al, 2012). Over-utilization of clinical resources is not only financially unsustainable but has been shown to lead to over-diagnosis, medication interactions, higher costs, unfavourable patient and family satisfaction, and deteriorating physician and staff satisfaction (burnout) (Krumholz et al, 2002; Gawande, 2009; Brownlee, 2010). Few studies have examined the efficacy of regular outpatient care on both patient outcomes and total system costs, especially in primary care (Chen, 2012; Jerant et al, 2012). As the American population ages and record levels of ambulatory care-sensitive conditions are diagnosed (Centers for Disease Control and Prevention, 2012), more proactive, cost-managed, and evidence-based population management models are necessary for appropriate policy formation.

The efficacy of primary care was at issue for our partner hospital whose management was considering deploying a new medical home, allocating more resources to primary care, and aligning primary care services along disease-specific service lines. Before making such strategic and financial allocations, strategic planners wanted to know the relationship between their primary care activities and their chronic disease patient outcomes. This question led to the creation of our case study. We proposed using newly available EHR data to address this question.

Before the study, one of our authors (Faber) led the hospital through a year-long data cleansing process that started at data entry and followed the patient encounter through to medical coding and billing. The project also included identifying tables in a Structured Query Language data repository that needed to be made available for reading. The hospital historically received its outcomes data at 6-month retrospective intervals from various consultants who purchased it from State and Federal sources. Thus, a pivotal outcome for the hospital was the opportunity for instant and free access to their own clinical data including the potential for customized ad hoc reports. Early projects provided descriptive information (admissions, discharges, ED patients, volume by disease); subsequent analyses offered evaluative information (average length of stay, discharge by

11:00 am, 30-day readmissions rate, 72-hour ED bounce-backs). This project represents a more complex multi-year evaluation that combines clinical, financial, and administrative data.

To assess the efficacy of regular outpatient care for chronic disease management, we examined all HF patients from the rural hospital's EHR for the years 2006–2011, totalling 556 patients. We assumed that for patients with an HF diagnosis, appropriate outpatient management would consist of regular provider interaction rather than sporadic, occasional consults. We used a retrospective-prospective cohort study to examine associations between regular outpatient contact, patient outcomes, and treatment costs. More specifically, we sought to use EHR data to determine:

1. How can 'regularity' of health care be empirically documented and evaluated?
2. Does regular (vs sporadic) HF outpatient care achieve better health outcomes?
3. Does regular (vs sporadic) HF outpatient care realize lower overall health system costs?

These questions were embedded within our larger research question that examined to what extent an EHR can be used to research and assess clinical and community health outcomes in a rural community hospital.

MATERIALS AND METHODS

Study Design and Population - Rural Health Care

The study site consisted of a rural hospital in Upstate New York. The hospital is located in a federally designated physician shortage area. The total population within the hospital's primary service area is approximately 35,000, of which 13% are 65 years and older. Located in the geographic centre of the county, the hospital has long operated as a centre of rural health services delivery within a 60-mile radius primary service area (PSA). Within this PSA, the hospital provides the only laboratory, radiology, ED, inpatient medical surgical services, and primary care clinic system. Physicians within the primary service area largely refer to the single hospital. The hospital operates in a large, rural, poor county. The population is 94% white, 86% are high school graduates, and 19% have a Bachelor's degree or higher. Median household income is US$43,390, 82.4% of the population has lived in the same home for more than 1 year, 17.6% of residents live below the poverty line, and county unemployment in April 2013 was 9.8% (DeNavas-Walt et al, 2012). Given our self-imposed restriction to only use EHR data, mortality, utilization, and system

cost were our primary metrics. As is usual practice in this hospital, our cost figures were based on a ratio of hospital charges adjusted for inflation and set to January 2012 amounts.

Data set

The data set consisted of 566 patients. We chose January 2006 as our study start date, which corresponded with primary care clinic purchases by the hospital. Patients' historic electronic data was selected if they received a principal discharge diagnosis of HF (ICD-9-CM: 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, or 428.9) between January 2006 and December 2011, providing for 5 years of data. Using ICD-9-CM codes to identify HF is consistent with other studies in the literature (Birman-Deych et al, 2005; Krumholz et al, 2009).

Using the EHR database we found each patient's first HF-related inpatient admission and recorded every encounter with the hospital system from that visit until a documented death or a point at which no further records appeared for six months. This created a retrospective-prospective account for each patient from first inpatient admission with HF to last encounter or 31 December 2011 when the study concluded.

Classifying Care Events

Even though many value-based purchasing projects emphasize some form of utilization metrics (e.g., number of procedures, or readmissions), we acknowledge that classifying patients by frequency of visit can be difficult and controversial. Working with the hospital's Chief Nursing Officer, we developed two classifying concepts to answer the primary question of whether or not primary care interventions influence more expensive and complex utilization: Interventions [I] and Unintended Events [UE]. Interventions are preventive in nature and include physician office visits, lab work, therapy, and related activities intended as preventive or care management. Unintended Events are undesirable encounters such as ED visits (and related observation hours), inpatient admissions, and Intensive Care Unit (ICU) admissions.

The category [UE] included 30-day readmissions – the primary Medicare metric for the hospital. We expanded the [UE] category beyond 30-day readmissions, however, to include ED encounters and observation admissions as these were considered costly and potentially avoidable events. We created an expansive definition of Interventions to catch patients whose primary care physicians (PCPs) were not employed by the hospital and as a consequence we would not have an electronic record of their PCP consultations. As these physicians refer patients to the hospital for ancillary services (labs, electro cardiograms (EKGs), therapy), we used documentation from these events as proxies for visits. Several studies note that primary care is delivered across a multitude of sites in addition to a primary care office (e.g., outpatient hospital department, medical or surgical specialty offices) (Schappert & Burt, 2006; Hing et al, 2010) and even while controlling for patient mix, visits to community health centers were more likely to be made by rural dwellers than visits made to other delivery sites (Forrest & Whelan, 2000). Comorbidities were established by examining the top three diagnoses (diagnosis sequence 1, 2, 3) (e.g., from the first three diagnoses in the record) for each visit.

We observed that some activities initially appearing to be [I] seemed to be part of a larger and more elaborate [UE], for example a follow-up visit with a PCP the same day a patient is discharged from an ED encounter or a direct inpatient admission from a primary care appointment. We account for such occurrences using 'Episodes of Care' (EoCs). EoCs combine one or more [UE]s and related [I]s during a short timeframe into a single Unintended Event. EoCs also combine several [UE]s if they occurred within a 30-day period. We explain this logic in Figure 1.

1. *If two or more [UE]s occurs within a 30-day period (e.g., readmission) these are combined into a single EoC and categorized as one [UE].*
2. *If an [I] occurs within 72 h before or after a [UE], the [I] and [UE] are combined to create a single EoC and categorized as one [UE].*
3. *Costs for all encounters (i.e., both [I] and [UE]) within the scope of the EoC are accumulated to generate the total cost for the EoC.*

Two cohorts were created from the data set: a 'Regular' cohort and a 'Non-Regular' (sporadic) cohort (patients with 'regular PCP encounters' vs 'sporadic/no PCP encounters'). A patient was classified into the Regular cohort if he/ she had at least two sets of three or more consecutive interventions over a 24-month period (not confined to calendar years). All other patients were classified as Non-Regular. Because of our time-limited definition of regular care, Non-Regular patients were filtered to exclude those whose first HF admission was in 2011 as they could not meet the 24-month stipulation. The two cohorts were mutually exclusive.

We hypothesized that patients with regular outpatient management (Regular) would be associated with different utilization, mortality, and cost patterns than patients who only sporadically received outpatient attention (Non-Regular). People who identify a PCP as their usual source of care are reported to benefit, regardless of their initial health or various demographic characteristics (Franks & Fiscella, 1998; Ionescu-Ittu et al, 2007; Cheng et al, 2010). Even if care with the same provider is not available, people with some sort of regular source of care (such as a particular clinic) seem to manage their diseases better than those without a regular source of care. Patients with regular primary care are more likely to have fewer hospitalizations (Gill et al, 2000; Friedberg et al, 2010), lower costs, and receive generally better preventive care (Starfield et al, 2005). Thus, regular primary care, regardless of the source, may be associated with better patient health outcomes and system-wide costs. The distinction between these two categories is further clarified in the Appendix with hypothetical patient examples.

The Regular cohort consisted of 272 patients with a median age at first inpatient admission for HF of 74.3; 53% were women. The Non-Regular cohort consisted of 294 patients with a median age at first admission for HF of 74.7; 54% were women. The data set consisted of 12,958 encounters from these 566 patients between 2006 and 2011.

We conducted a retrospective-prospective analysis using SAS and Microsoft Excel for statistical analysis. Normality testing was conducted using SAS software (Shapiro–Wilk test, Kolmogorov–Smirnov test, and Anderson–Darling test) and by observing data plots. Because our data did not follow a normal distribution, hypothesis testing was per-formed using the Wilcoxon Rank-Sum Test. A two-tailed P-value < 0.05 was considered statistically significant.

RESULTS

Of the 566 patients in our study, 88% had encounters for any reason with the health system before 2006 and 64% had health records preceding 1997 (10 years prior). Forty-eight percent had a 'heart'- or 'chest'-related encounter (not inpatient admission) before 2006 (i.e., 'chest' or 'heart' identified in 'Reason for Visit' EHR field). Table 1 compares and contrasts the two cohorts. Given our self-imposed restriction to EHR data, socio-demographic information was obtained solely from EHR data. Post 2006, Regular and Non-Regular cohorts had similar inpatient severities as measured by the Case Mix Index, and no statistically significant demographic disparities between cohorts.

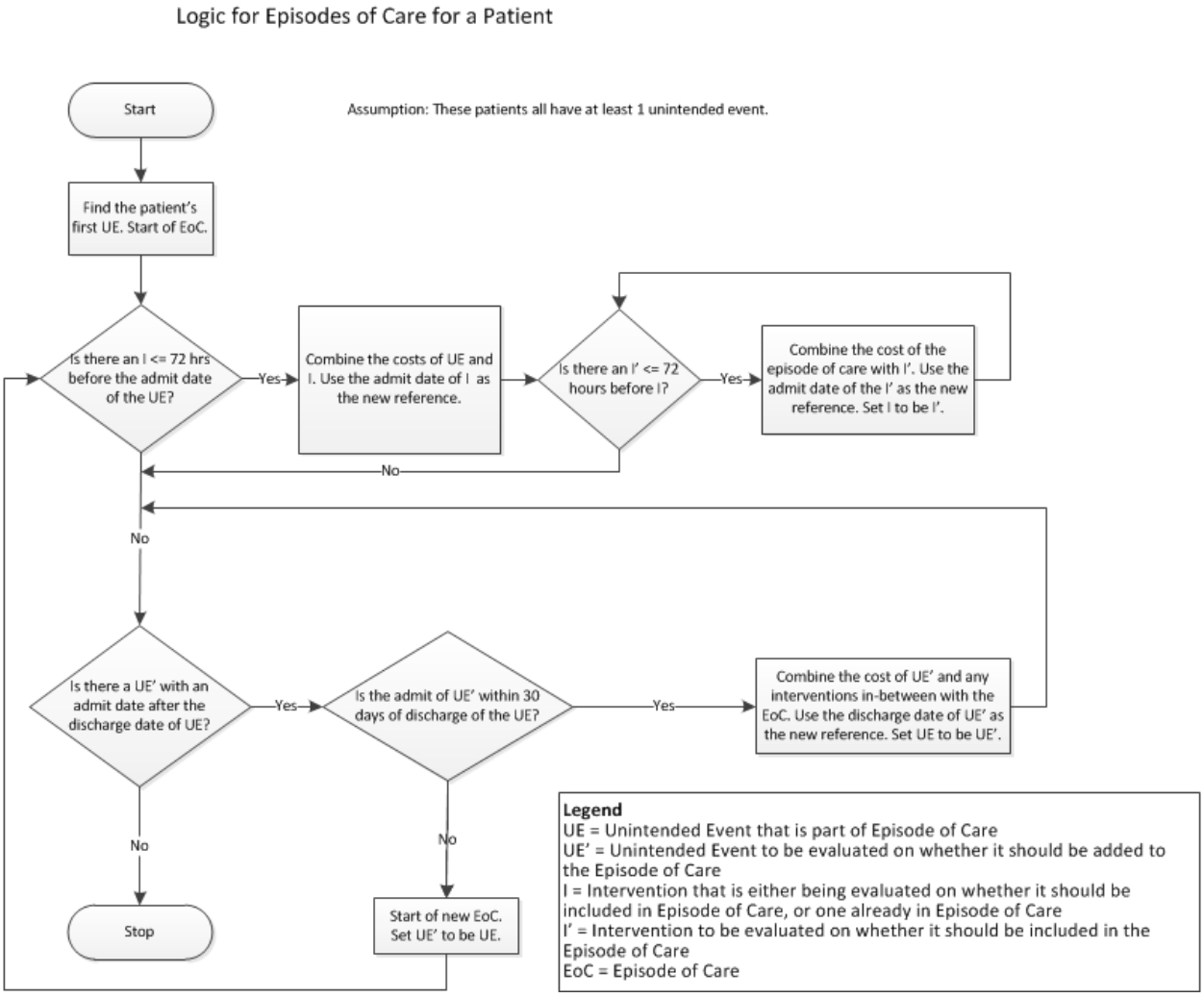

Figure 1 Logic Used to Define Episodes of Care (EoC)

Table 1: Characteristics of Regular versus Non-Regular Patient Cohorts

Characteristic	Regular	Non-Regular
Cohort Size	**272**	**294**
Mean Age at First Heart Failure (HF) Admit	**73.4**	**74.7**
Standard Deviation Age at HF Admission	**12.4**	**15**
Women	**53%**	**54%**
Medicare	**76%**	**75%**
Commercial Insurance	**13%**	**16%**
Uninsured	**5%**	**2%**
Race	**99% Caucasian**	**98% Caucasian**
Case Mix Index	**1.17**	**1.22**

Table 2: Comorbidities by Cohort

Comorbidity	**Regular**	**Non-Regular**
Hypertension	91%	68%
Hyperlipidemia	70%	42%
Coronary Atherosclerosis	63%	41%
Anemia	63%	39%
Diabetes Mellitus Type 2	53%	38%
Atrial Fibrillation	48%	38%
Cardiomegaly	46%	34%
Chronic Airway Obstruction	45%	41%
Pneumonia, Organism	45%	38%

Table 3: Results for Average Episode of Care (EoC) Cost (Inflation Adjusted) for Regular versus Non-Regular Patient Cohorts

Result	Regular	Non-Regular
Mean EoC $	**$8,120**	**$11,102**
Standard Deviation EoC $	**$5,828**	**$10,150**
Mean EoC / Year	**1.5**	**2.2**
Years in Study	**3.09**	**1.29**
% Deceased or Hospice	**13.6%**	**23.5%**
Average Length of Stay (LOS)	**4.0**	**4.5**
30 Day Readmissions	**15.6%**	**20%**
Case Mix Index	**1.18**	**1.22**
Mean EoC $	**$8,120**	**$11,102**

Over the study period, patients with regular outpatient management lived, on average, 1.8 years longer than those in the Non-Regular cohort. Fewer Regular patients (13.6% vs 23.5%) were discharged deceased or to hospice care over the study period. Regular patients had fewer annual inpatient or ED events and fewer 30-day readmissions (P = 0.01). When an [UE] did occur, Regular patients incurred, on average, 27% lower mean EoC costs (P = 0.0003). Regular patients also had less variability in the cost of these [UE]s, reported as standard deviation (Table 3).

We examined prior utilization for both cohorts. Neither group was predominantly 'new' patients in the sense that they had never seen a physician before their first HF admission in the study period of 2006 through 2011 (89.7% of Regular patients had an encounter before 2006 vs 86.4% of Non-

Regular patients). However, Regular patients do show a slightly greater proclivity toward historically accessing health services (68.9% of Regular patients had encounters before 1997 vs 59.5% of Non-Regular patients). In addition, 55.1% of Regular patients had some sort of 'chest'- or 'heart'-related encounter before 2006 compared with only 41.5% of Non-Regular patients.

Table 2 shows that Regular and Non-Regular cohorts had similar comorbidities but a greater percentage of Regular patients had chronic comorbidities.

DISCUSSION

The principle contribution of our work is to describe and demonstrate a method for using EHR data to assess health-care outcomes within a stand-alone, community hospital. We suggest that if used appropriately, EHR data could be a 'game changer' for smaller hospitals lacking larger research affiliations or academic collaborations. We found that for the purposes of documenting and assessing care outcomes, the data available within this hospital's EHR was sufficient for retrospective descriptive studies, hypothesis testing, and, we anticipate, potentially for predictive studies. The measures selected for the case study may not be ideal; however, they represent data that is available in most rural hospitals. For instance, accounting for cost is problematic in many small hospitals. The study hospital does not use cost-accounting software, but rather a cost/charge ratio for its internal metric. Similarly, quality of life is widely recognized as an important outcome parameter in the study of cardiovascular diseases, rather than mortality. An alternative method or supplemental methods for recognizing costs and quality of life, respectively, continues to be of great concern and could lead to productive research in how to obtain these measures from EHR systems.

Empirically documenting and evaluating "regularity" of health care

One product of this study is an empirical definition of regular care. Although there is a strong body of literature advocating the benefits of 'regular care', there is no quantifiable definition. While our study makes such an attempt, the definition and assumptions made in this study should be explored further using sensitivity analysis, particularly the definition of time intervals. Our study might also have been limited by an overly restrictive definition of a Regular care patient. A future study could

relax this definition, for example to allow for interspersed [UE]s within each set. Similarly, we recognize that our study design may have biased Regular patients toward fewer unintended events [UE]. Thus, our claims are not driven so much by the frequency of [UE]s as the intensity and costs of the entire EoC. In addition, the cohorts were retroactively constructed from historical utilization pat-terns that emerged from the data set. Future studies could contrast and possibly optimize the frequency of [I]s. Furthermore, this study did not use a time-to-events analysis to examine mortality. However, the study is not intended to demonstrate comprehensive statistical analysis, but rather to illustrate the extent of the data available from EHRs and how this can lay the foundation for modelling studies in contexts where such advanced resources may not be available.

Regular (vs sporadic) HF outpatient care achieves better health outcomes

The hospital's EHR data showed that patients diagnosed with HF in this rural health-care setting appeared to benefit from regular outpatient management of their condition (defined as at least two sets of three or more consecutive visits over 24 months). This finding is consistent with and adds to the research literature. The data showed that neither group consisted of 'new' patients in the sense that new patients had never seen a physician before the beginning of the study. Yet patients in the Regular cohort, on average, lived longer and incurred fewer episodic costs. These episodic costs appear to be the result of fewer readmissions. As such, regular outpatient management after heart failure-related admission appears to be associated with lower mortality rates and less costly and more predictable unintended events. The rural setting, relative isolation of the hospital community, and associated low demographic deviation have a mitigating effect on the complicating factors underlying many longitudinal care studies (Andersen et al, 2011). In addition, the EHR data enabled us to capture utilization and reimbursements.

Regular (vs sporadic) HF outpatient care realized lower overall health system costs

The study has several useful implications for health system management and planning – particularly discussions about patient-centred medical homes, bundled payments for chronic disease management, Accountable Care Organizations, and other methods for population health management. We were able to use the hospital's data to model patient outcomes in one complex and problematic service line. Patients with regular outpatient management of their condition not only had less costly EoCs but, perhaps more importantly, less variation (as reported by standard deviation) in these costs. The finding provides evidence that preventive care can lead to more

predictable costs. Reducing variation makes cost anticipation, utilization anticipation, and overall health system planning more predictable. These findings provide both medical and financial evidence for policies and efforts regarding structured programs for chronic care management.

The above description has implications for managing chronic disease populations as it suggests that social and behavioural determinants of health should be a part of care management. As health systems endeavour to promote systems for managing chronic care, efforts to build trust with patient groups should be carefully considered. This study suggests that a component of the population may not be sufficiently engaged with the health system until it is too late, and this detachment has negative consequences for patients, the hospital, insurance coverage, and the larger system.

Our experience using EHR for health services research

Methodologically, we found that retrospective data studies from EHR data can produce useful aggregate accounts of actual patient activity, though not without limitations. Using this data for hypothesis-driven models for testing requires considerable data manipulation and cleaning to make past events fit into somewhat inexact structures. As an example, the hospital's EHR was not integrated with non-affiliated clinics, pharmacies, or other hospital services. This lack of integration limited our ability to reference pharmacy data and required assumptions to equate lab testing, stress testing, and other secondary encounters with outpatient management. It also meant that we could not determine whether patients had encounters in other hospitals – a limitation perhaps more crucial in geographic areas where hospitals compete for the same patient. While our work-around allowed us to catch those patients from stand-alone clinics not connected to the hospital EHR, the assumption may have over-represented the number of [I]s. We attempted to mitigate against this design issue by examining the overall patient outcomes and cost patterns associated with those outcomes. Subsequent to this study, our project team has used EHR data to model various prospective Bundled Payment programs, determine the results of a surgical site infection reduction project, examine the 90-day post-discharge utilization of various disease cohorts, and study the effect of various practice changes to an oncology service line. None of these projects would have been possible before the EHR data project.

The methods for such studies remain open for discussion and require inputs from the larger health systems research community. Not only can researchers help with the design and models emerging from EHR data but, perhaps more importantly, the research community needs to be involved in helping health systems choose which variables to include at data entry points, and in helping to determine how to validate, extrapolate, and compare/ benchmark the results from such studies.

As meaningful use guidelines and objectives intend, EHR data could offer a more immediate and cost-effective research alternative for smaller hospitals without an allied academic center. When properly structured in ways that recognize their scientific limitations, such studies can be carefully used alongside the research literature and best practice protocols to test the effectiveness of treatments, protocols, and systems of care. Given that most EHR systems have evolved from accounting software, perhaps their most immediate and least medically sensitive application can be in cost comparison studies and other studies that measure and account for financial irregularities across a health system.

CONCLUSION

EHRs present an opportunity for care management studies and analysis. This is particularly valuable for rural hospitals lacking the data infrastructure of large research systems. We provide a use case of how a rural hospital is able to use its EHR to examine utilization patterns of HF patients. In doing so, we also illustrate how such data can be used to empirically define regular care. The use case itself found that regular preventive care engagement not only remains essential for maintaining patient quality of life but is also financially beneficial and more sustainable for the larger health-care system. While the use case demonstrated the potential of using EHR for such studies, the method revealed a number of open problems including the quality of EHR data, the quality of guidelines, and the availability of costs and outcome parameters.

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APPENDIX A

The examples below outline utilization patterns for patients considered to be Regular and Non-Regular. The examples are illustrated in Figure A1.

Example 1: Patient 1 (Regular) had two sets of three consecutive interventions within a 24-month period interspersed with one unintended event (the hospitalization on 3 March 2010). Even with the unintended event, this patient is considered a Regular patient as he/ she met the definition for regular preventive care visits.

Example 2: Patient 2 (Non-Regular) has an initial hospital stay and a series of PCP visits. However, the visits do not meet the criteria for regular care as there are fewer than two sets of three interventions.

Example 3: Patient 3 (Regular) had three consecutive interventions in 2010, followed by three consecutive interventions in 2011. These were within 24 months, so the patient is classified as Regular.

Example 4: Patient 4 (Non-Regular) has two series of at least three interventions; however, they do not fall within the 24-month period.

Patient 1: "Regular"

Encounter	Reason for Visit	Date
I	Clinic Visit	3/2/2009
I	Clinic Visit	9/1/2009
I	Lab work	1/6/2010
UE	Hospitalization	3/3/2010
I	Clinic Visit	5/7/2010
I	Stress Test	8/19/2010
I	Clinic Visit	11/22/2010

Patient 3: "Regular"

Encounter	Reason for Visit	Date
I	Clinic Visit	2/3/2010
I	Stress Test	7/6/2010
I	Clinic Visit	11/12/2010
I	Clinic Visit	1/10/2011
I	Lab Work	5/19/2011
I	Clinic Visit	10/21/2011

Patient 2: "Non- Regular"

Encounter	Reason for Visit	Date
UE	Hospitalization	4/17/2007
I	Clinic Visit	9/12/2007
I	Lab work	4/3/2009
I	Clinic Visit	12/16/2009
I	Stress Test	1/19/2011
I	Clinic Visit	12/22/2011

Patient 4: "Non- Regular"

Encounter	Reason for Visit	Date
I	Lab work	9/12/2007
I	Stress Test	1/4/2008
I	Clinic Visit	4/18/2008
UE	Hospitalization	12/3/2010
I	Clinic Visit	1/14/2011
I	Stress Test	6/17/2011
I	Clinic Visit	12/21/2011

Figure A1 Examples of Patients Exhibiting Regular and Non-Regular Care