Title
Characteristics and Impacts of RN Case Management Interventions in a 65+ year old Community-Dwelling, Chronic Disease Population

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The Impact of RN Case Management on Inpatient and ED Utilization in a Chronically Ill, Older Adult, Community-Dwelling Population

by

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DISSERTATION

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ABSTRACT

This study examines the characteristics and impacts of RN case management on patients' inpatient and Emergency Department (ED) admissions in a 65+ Medicare-enrolled community-dwelling, chronically ill population. Data are from a multi-year randomized controlled trial (RCT) of Medicare Coordinated Care Demonstration (MCCD) program participants in the Carle Clinic healthcare system. This study is a secondary analysis of case management data on 1551 treatment group patients from 2002 through 2005. All patients had at least one of five qualifying chronic health conditions: atrial fibrillation, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease/asthma or diabetes mellitus. Patient characteristics were analyzed to determine association with increased admission risk. The timing and time allocated to RN case management interventions for all participants were analyzed to document case management activities in each of 21 standardized nursing care categories. The association of case management activity type, timing and time with all-cause ED and inpatient admission and readmissions was analyzed to determine which case management activities reduce or increase ED admission or inpatient admission/readmission risk.

Analysis revealed that age, gender, race, urban or rural status, or number of diagnoses were not significantly associated with risk of all-cause inpatient readmission. Of 14 RN Case Managers, 6 were associated with significant reductions in all-cause readmission risk, and one was associated with increased readmission risk. The Identify Needs: Medicare activity, which can include indentifying the need for inpatient or outpatient Medicare-covered health services, was associated with a decrease in inpatient readmission log odds. All Monitor case management activities and Patient-specific

Travel were significantly associated with increased ED admission hazard. A final multivariate model identified CHF (OR 2.7, p=.01), as well as Assessment (OR 1.06, p=.03) and Identify Needs (OR .663, p=.06) activities as the strongest predictors of inpatient readmission risk. Patients with 1 inpatient admission versus patients with 2+ admissions received significantly greater amounts of case management time in the categories of Assessment, Identify Needs: Medicare, and Identify Needs: Non- Medicare in most 0-180 day intervals after an index admission. These results indicate that RN case management intervention type, timing and time (amount) were associated with reduced readmission risk in the study population.

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INTRODUCTION

Longer life expectancies and a burgeoning over-65 population have created a growing population of chronically ill, community-dwelling older adults. One hundred and fifty seven million Americans are expected to be living with one or more chronic illnesses in the year 2020 (Crawford, Fuhr, Clarke & Hubbs, 2005). Chronic illness accounts for three quarters of total U.S. health expenditures (Bodenheimer et al., 2002). Five chronic diseases now account for approximately half of all U.S. healthcare expenditures: asthma, diabetes, heart disease, hypertension and mood disorders (Tsai, Morton, Mangione, & Keller, 2005). Eighty-eight percent of people aged 65 and over have one or more chronic diseases. In response to these age/chronic disease phenomena, programs designed to improve providers' adherence to evidence-based treatment standards and patients' self-care abilities are now being piloted and evaluated by the Centers for Medicare and Medicaid Services (Brown, Peikes, Chen, Ng, Schore, & Soh, 2007).

Studies of how RN (nurse) case management can promote improved health and healthcare outcomes in chronically older adults are needed. RNs play an integral role in providing inpatient and outpatient care coordination for chronically ill older adults. There are limited studies addressing how RN interventions in collaboration with other health providers can best be targeted to improve care in chronic illness care in older adults. This research aims to identify characteristics of RN case management in an RCT population of chronically ill, older adults, to document the impact of these RN varied interventions on ED and inpatient admissions, and to begin to identify how RN case management can reduce ED and inpatient admission risk.

Background and Significance

Care for Medicare beneficiaries with chronic diseases is complex, often involving an average of 11 different physicians per year, and representing a major expense to the Medicare program (Brown et al, 2007). Older adults with multiple medical problems, functional deficits, cognitive impairment, behavioral health diagnoses, and poor self-care behaviors are at increased risk of adverse outcomes during the transition from inpatient acute care (Naylor, 2000). Studies of the application of evidence-based practices in chronic care management have documented positive outcomes of care coordination and patient self-management in chronic disease populations (Wagner, Austin, & VanKorff, 1996). Researchers have documented that acute health problems caused by chronic diseases can be prevented or controlled if patients are provided with care that is consistent with recommended standards, when patients adhere to recommended diet, medication, exercise and self-care regimens, and when providers communicate better with each other and patients (Brown et al, 2007).

The Chronic Care Model

Use of the Chronic Care Model (Wagner et al., 1996) in chronic care delivery is one means of improving patients' quality of care and health outcomes. In Tsai and colleagues' (2005) meta-analysis of 112 RCTs and controlled trials in the chronic disease management of CHF, depression, asthma, and diabetes, researchers extracted data from (predominantly) outpatient studies on clinical outcomes, quality of life, and processes of care. Tsai and colleagues found that in studies in which at least one Chronic Care Model element was offered in chronic care delivery, that positive clinical outcomes were often identified, depending on the disease diagnosis.

Nurse Case Management Interventions

Care coordination is a structural element of the Chronic Care Model. On this subject, there is a range of research assessing the use of trained case managers interacting with clinical team members to support patient treatment goals in chronic disease management (Reuben, 2007; Walsh, Simpson, Wan, Weiss, Alexander, Markson, et al., 2002). In Hamner's (2005) systematic review of RCTs and quasi-experimental clinical research involving the study of nursing interventions for patients with CHF, the author documented the impact of specific nursing interventions on patient outcomes. The interventions included home-based services with telephone follow-up, multi-disciplinary interventions in the home setting with RNs acting in pivotal roles, nurse-coordinated heart failure clinics, and RN telephone/technology-based interventions. Of the four domains of case management reviewed, evidence of association of nursing intervention(s) and decreased mortality and improved quality of life was found in the model of RN-driven, multidisciplinary care in the home setting. Evidence of association was demonstrated for RN-led CHF clinics and reduced hospital and ED admissions, decreasing mortality, improved quality of life, improved self-care, and reduced health services costs. Evidence regarding the statistical significance of the impact of RN-only home-based nursing interventions on patient outcomes, and related health services utilization and cost, was not fully documented in the Hamner study.

Some of the measured outcomes of chronic disease management studies are significantly positive, some are not. Case management (CM) processes have been shown to improve quality of care, specifically for patients with CHF, Diabetes, COPD, and mixed comorbidities (Casalino et al., 2003; Wheeler, 2003). In Norris et al.'s (2002)

review of over 50 studies evaluating the effectiveness of disease management (DM) and case management interventions for diabetic patients, the researchers concluded that evidence demonstrated improved patient outcomes in a number of areas. These areas included glycemic control, diabetic retinopathy screening, screening for foot lesions and peripheral neuropathy, proteinuria, and lipid monitoring. Ofman et al., (2004) found in their systematic review of 102 studies on 11 chronic conditions that DM programs were associated with improvements in quality of care, in particular for patients with CHF, hyperlipidemia, and coronary artery disease (CAD). Weingarten et al., (2002) reviewed 102 articles evaluating 118 DM programs and concluded that most DM programs used more than one intervention, and that provider education, feedback and reminders were associated with significant improvements in provider adherence to guidelines and significant improvements in patient disease control. Reductions in hospitalization costs have been demonstrated for DM programs for CHF (Rich et al., 1995) and Diabetes Mellitus (Aubert et al., 1998), and for geriatric unit consultation and related care management provided before and after acute care discharge (Inouye, Bogardus, Baker, Leo-Summers, & Cooney, 2000). Several studies of cost effectiveness of DM in CHF patients have shown increases in survival but no decrease in related health services costs (Galbreath et al., 2004).

As noted previously, some research findings on case management effectiveness are negative or mixed. In one RCT study of effectiveness of a social work (rather than RN) care management model among health maintenance organization members, findings did not demonstrate cost savings (Boult et al., 2000). In another study, case management provided without collaboration with primary care physicians also failed to demonstrate

cost savings in a large case-control study of Medicare HMO chronic disease patients (Newcomer, Maravilla, Faculjak & Graves, 2004). In this study, intervention group patients with impairment of three or more activities of daily living were one-half as likely to have a nursing home admission. In a 2007 systematic review (Chiu & Newcomer, 2007) of 15 clinical trials of nurse assisted-case management intended to improve transitional care outcomes, the authors found reduced all-cause and CHF readmissions or fewer hospital days in patient populations in the case of 8 of 15 study interventions. In this systematic review, reduced ED visits were identified as an outcome in three case management effectiveness studies.

Explanations for the absence of cost-benefit in some studies' findings include the fact that DM guidelines have been in place for a while, and as a result there is a smaller margin for improvement and fewer opportunities for dramatic reductions in inpatient hospitalization and related costs. Another explanation may be the limited number of randomized controlled studies on the millions of American adults now living with 2 or more chronic diseases. Garis and Farmer (2002) noted that there has been a dearth of research specific to analyses of economic and noneconomic outcomes of care for patients with comorbid conditions. Care coordination does hold the promise of moderating health care costs while improving quality of care for the chronically ill, though there is limited evidence still on which chronic disease management programs work and which work best (Chen, Brown, Archibold, Arliotta, & Fox, 2000).

Current Research in Care Coordination in Chronic Disease

A major effort was initiated by the Centers for Medicare & Medicaid Services (CMS) to further examine the impact of care coordination in a multi-site clinical trial

known as the Medicare Care Coordination Demonstration (MCCD) program. The MCCD is the second evaluation of case management and disease management programs within a Medicare fee-for-service context. The MCCD is a six year demonstration project funded by CMS with 15 individual sites and programs targeted to beneficiaries with chronic conditions that generate high costs to the Medicare program. The initial (2 year) results of that RCT demonstration are reported elsewhere by Brown and colleagues (Brown et. al., 2007).

RNs have played a central role in the MCCD studies conducted to date and have delivered care interventions guided by Wagner's Chronic Care Model (Wagner et al., 1996): prevention of exacerbations and complications; early detection of functional impairments; proven, evidence- based treatments; support for patient self management; and help with the emotional toll of chronic illness. Analysis of RN case management activity and timing is an important component of chronic care research. This type of research can aid in identifying the impact of specific kinds and timing of interventions on patients' symptoms, self-care abilities, and health services utilization, and related costs. The MCCD RCT, and the analysis of secondary data from the Carle Clinic (Champaign, Illinois) MCCD described here, aims to accomplish this task. Findings from this analysis can help define how RN case management resources are used in chronic disease management, how patient characteristics may influence the timing and intensity of these resources, and whether and when case management intervention impacts ED and inpatient admissions.

The Interface of Chronic Care Management and Acute Care Transitional Care

Forster and colleagues' (2003) research on adverse events following acute inpatient discharge revealed that all preventable or ameliorable adverse events were due to one or more healthcare system design deficiencies (Forster, Murff, Peterson, Gandhi, & Bates, 2003). These deficiencies are symptomatic of what Greenwald and colleagues (Greenwald, Denham, & Jack, 2007) referred to as "unstandardized and unstructured" transitional care processes. Naylor and colleagues argue that 25% of readmissions for CHF patients are avoidable and related to inadequate transitional care (Naylor, Brooten, Campbell, Maislen, McCauley, & Schwartz, 2004). Research by Naylor and Coleman and colleagues (Bowles, Naylor, & Foust, 2002; Coleman, Smith, Frank, Min, Parry, & Kramer, 2004; Naylor, 2000) among others has addressed these fragmented care issues by developing transitional care models based on Wagner's Chronic Care Model (1996). These transitional care models incorporate evidence-based healthcare, cross-setting care coordination and communication, self-care education and cross-discipline coordination and communication. All of these evidence-based transitional care coordination elements were included in the Carle MCCD care delivery model.

Naylor's model of Transitional Care Quality (Naylor, 2000) emphasizes the deployment of skilled, Advanced Practice RNs, self-care education, and system design elements of monitoring and follow-up. Coleman's model emphasizes system design elements of patient-provider communication, and cross-setting physician communications. Inpatient providers' incorporation of the Chronic Care Model and Disease Management (DM) principles of risk stratification, evidence-based care, patient and caregiver education and self-management skill has been proposed as one method of

standardizing transitional care (Davis, 2007; Wagner, Davis, Schaefer, Vonkorff & Austin 1999; Vladeck, 2001; Zinn & Mor, 1999).

Models of care coordination for older adults that reflect the complexity of older adults' clinical transitions are needed. Gaps in research include identification of patterns of post-acute care, including frequency and complexity of patient contact, and the relationship of care coordination activities to post-acute outcomes, including patient safety and health services utilization (Boockvar, Fishman, Kyriacou, Monias, Gavi, & Cortes, 2004; Boockvar, Fridman, & Marturano, 2005; Bowles, Foust, & Naylor, 2003; Forster et al, 2003). Additional research is needed to identify organizational structure and process variables that can create desired acute care transition outcomes in older adults with complex chronic diseases. These studies are essential to building a model of transitional care coordination that incorporates the needs of patients of varying chronic diseases, disability levels, and self-care capabilities. An evidence-based model of transitional care that can be adapted to a range of care settings and that is standardized is needed. The study described here was conducted in part to define characteristics of such a model

Purpose of Research

This research intends to add to the limited evidence base in RN chronic care management of older adults, its impact on the risk of ED admission and inpatient/readmission, and its application in cross-setting transitional care management. Assessing the effectiveness of RN case management interventions is a necessary component of developing an evidence base for chronic care management of community-dwelling older adults. Providers and payors of chronic care management can benefit from

clinical research on older adult patients' outcomes of Chronic Care Model-guided healthcare, as can older adults.

A primary research aim was to identify if RN case management interventions in a chronic disease population were associated with reducing all-cause ED use and inpatient hospitalizations, both admissions and readmissions. This study uses data from one of the MCCD sites to explore in depth the differences in inpatient and ED admission risk experienced by patients with chronic conditions, the actions taken by the RN case managers in response to patients' disease management needs and inpatient/ED admission events, and the relationship between patient and case management characteristics and the risks of admission and readmission. This research further aimed to identify which combination of RN activities, among 21 distinct nursing assessment, intervention and evaluation activities, was associated with a statistically significant reduction in ED and inpatient hospital admissions and readmissions. Identifying and then measuring the pattern of MCCD case management activity in relationship to acute care admissions and readmissions was an important component of this study. Effective care coordination in chronic disease patients during acute care transitions can reduce readmissions (Naylor et al., 2004), and this study included review of documented care coordination activities within ED and inpatient transitions. In support of the primary research aim, the study aimed to identify and describe structural and process features of RN case management interventions in a chronically ill, older adult, community- dwelling population. More detailed definitions of the case management categories used to capture/aggregate case management activity are provided in Appendix E.

Structure, Process, and Outcome Variables

Inpatient and ED admissions and readmissions are the primary outcome measures used in this study. All-cause admissions and readmissions were selected as an outcome because only the primary admission diagnosis is available in the MCCD data set and data on additional diagnoses are not available. RN case manager activity/intervention type, quantity, timing and amount (in minutes) are the primary process measures utilized in this study. Patient- level demographic and diagnostic variables are 1 of 2 structural variable categories used in this research; the second category represents the RN Case Manager-level variable of RN identification number. These structural and process measures were employed to describe and then analyze the nature of the Carle MCCD's RN case management activity.

In this study, inpatient and ED admission and readmission risk were separately analyzed for patients in each of the qualifying primary chronic disease categories; this was done to control for the impact of primary chronic disease on admission and readmission risk within the risk estimation models. The outcome of inpatient admissions/readmissions was emphasized in this study, compared to ED admission and readmission outcomes, because inpatient readmissions are more frequent, costly and often disruptive outcomes in older adult, chronically- ill populations

Theoretical Framework

The primary model guiding this research is the Chronic Care Model (CCM) (Figure 1), which is based on Donabedian's quality of health care outcomes model (1966). Donabedian's model conditions the production of desired patient outcomes on health system and organization-level structures and processes that are empirically linked to quality outcomes. This research evaluated components and outcomes of the MCCD

Care Coordination Model, which itself was based on Donabedian's general structure, process and outcome (SPO) model of quality of care. The MCCD research design incorporated all the structural and process elements of the Chronic Care Model. These CCM features are illustrated in Figure 1.

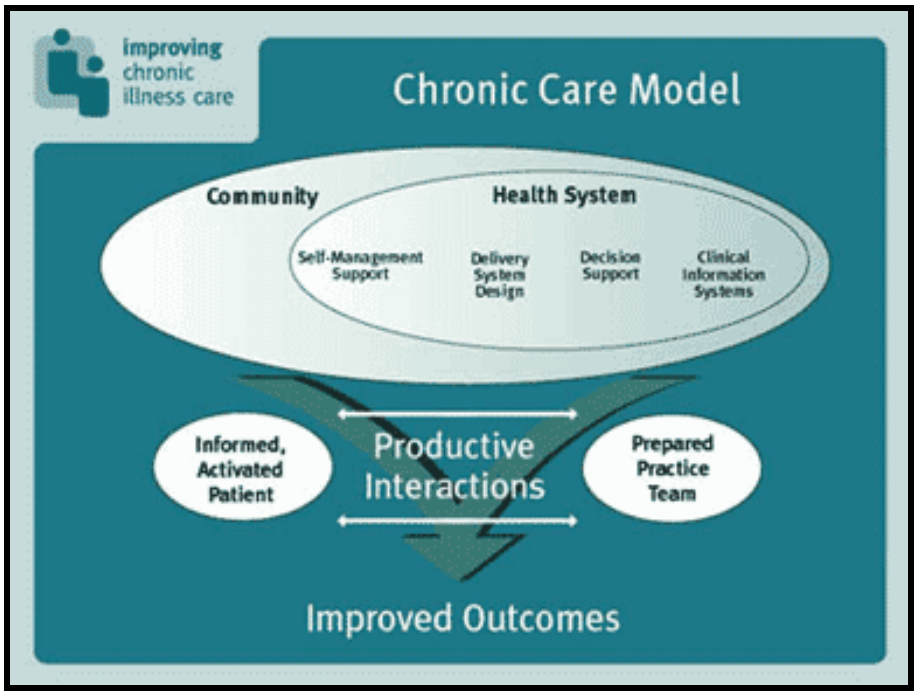

Figure 1. Chronic Care Model (Wagner et al., (1999), from the Institute for Health Improvement, 2007)

The CCM holds that specific elements of structure, process, input and contextual elements that are integrated within an evidence-based delivery model generate quality healthcare outcomes for chronic disease patients. Structural elements include delivery system design, clinical information systems/IT, decision support elements such as

evidence-based clinical guidelines and decision-support, and health care providers. Process elements can include care management, patient-provider communications, and performance measurement. Inputs to structure and process can include competencies of clinicians-RNs, physicians, other clinicians in chronic care management, and the level of engagement of patients, caregivers and clinicians in chronic care management.

Figure 2 depicts a theoretical framework that is an elaboration of the Chronic Care Model. This model illustrates how case management overlaps with and incorporates disease management; these care processes in turn interface with the system, provider and patient elements described in Wagner's Chronic Care Model. In this elaborated model, case management and disease management influence patient knowledge and skill, in turn improving chronic disease patient self-care and symptom management ability. Patient self-care competence is associated with improved short-term health status improvements and clinical indicators such as glycemic or lipid control, and enhanced self-efficacy. These short term improvements in turn generate longer term health improvements (such as control of microvascular and macrovascular disease), enhanced quality of life, and decreased mortality (Norris et al, 2002). The incorporation of targeted disease management and self-care education in the Carle MCCD was intended to achieve these short and long term improvements in patient health status.

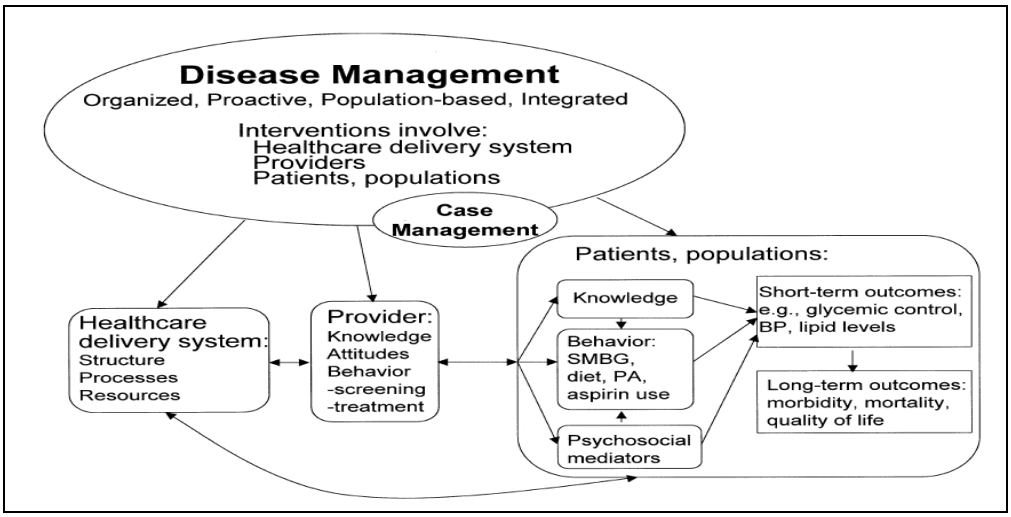

Figure 2. Disease management conceptual model. From Norris et al., (2002). The effect of case management and disease management for people with diabetes, *American Journal of Preventive Medicine*, 22(4S), 15-38.[1]

Research Questions

This research was conducted to answer the following questions:

1. What were the demographic features of the MCCD population in terms of age, gender, Race/ethnicity, urban versus rural residence?

2. What were the chronic disease characteristics of the patient populations in terms of the number of diseases overall and primary major chronic disease?

[1] Ovals denote interventions, rectangles with rounded corners denote short-term outcomes, and rectangles with squared corners denote long-term outcomes. BP, blood pressure; PA, physical activity; SMBG, self-monitoring of blood glucose

3. What patient demographic or clinical characteristics were associated with reduced or increased inpatient and ED admission hazard?

4. Were inpatient and ED admissions or inpatient readmissions* (*defined as >1 inpatient or ED admission) significantly associated with either selected patient demographic variables or number/type of diagnoses?

5. What were the characteristics of RN case management activities over the study period in terms of time allocated to the standard 21 case management activities?

6. Was there a significant difference in case management activity type, timing and time allocated for patients who were admitted to the ED or readmitted to inpatient settings compared to those who experienced only one inpatient admission?

7. Were individual RN Case Managers significantly associated with odds of admission or readmission? If so, how did readmission risk differ among RN Case Managers among patients with different primary chronic disease diagnoses?

8. Did variation in case management time and timing explain significant variation in readmission risk for patients in discrete primary chronic disease categories?

9. What specific case management activity (activities) were associated with reduced or increased inpatient admission or readmission risk/hazard and ED admission hazard?

10. Can a statistically significant dose (amount/type of case management time) response relationship between RN case management and admission or readmission risk be identified?

In this study, I expected that the case management interventions, representing an evidence-based structural element of quality chronic care, would improve patient outcomes by supporting processes of disease monitoring, self-care, coordination with primary care providers, and symptom management. This is consistent with the theoretical framework of the Chronic Care Model. I also expected that RN Case Manager time spent in targeting interventions in these domains of chronic care management would aid in minimizing exacerbations of symptoms and subsequent, related ED and hospitalization utilization. This is consistent with Naylor's and Coleman's and colleagues' theories of quality transitional care, which in turn incorporate Donabedian's SPO theory of quality care.

METHODS

This study uses data from the Medicare Chronic Care Demonstration (MCCD) program operated by the Carle Clinic Association healthcare system, Illinois. This site and the other 14 MCCD sites were funded by the Centers for Medicare and Medicaid Services (CMS). The MCCD sites operated from 2002-2008 implementing and evaluating various coordinated care programs. Authorized by Section 4016 of the Balanced Budget Act of 1997, the MCCD tested a number of care management and disease management delivery models designed to improve the care and quality of life of chronically ill beneficiaries who receive Medicare fee-for-service benefits. CMS funded demonstration projects to assess whether coordinated care programs can improve medical treatment plans, reduce avoidable hospital admissions and promote behavioral and clinical outcomes without increasing program costs. The 15 programs, representing both urban and rural settings, began enrolling patients in April, 2002 for the six year study.

MCCD sites were enabled to design their own care coordination interventions, and at the end of year two, MCCD evaluators identified the site program features of the most successful care coordination programs. These features were: targeting of high risk individuals, having a comprehensive, structured intervention adaptable to individual patients, having highly trained and actively involved providers (specifically baccalaureate prepared RNs or RNs with case management/community nursing experience), and using financial incentives to motivate programs to meet patient needs and reduce preventable hospitalizations and related costs (Brown et al., 2007).

Sample

Patients

Participants in the Carle Clinic MCCD program were recruited from Carle Clinic system-affiliated primary care providers. All these providers are in community-based practices located in central Illinois. The Carle Clinic Association primary care providers are part of a 300-physician specialty and multispecialty private practice with 10 outpatient care sites, representing one of the largest private group practices in the U.S.

To be eligible for the MCCD, a patient had to be age 65 or over (with the exception of younger adult patients enrolled with permanent medical disability), with Medicare Parts A & B, with at least one of five qualifying chronic health conditions: atrial fibrillation, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease/asthma or diabetes mellitus. A total of 3,014 persons enrolled in the Carle MCCD study. About half of these (n=1551) were randomly assigned into the RN (nurse) case manager intervention, the remaining half to usual chronic care provided by patients' existing primary care provider (PCP). Patients began enrolling in the Carle MCCD in 2002 and were tracked for up to six years (through 2007) if they remained in the program. Data analysis in this study was limited to those patients participating in the intervention group for the 2002 through 2005 period, the period for which data was available at the start of this study. The Carle MCCD research design included an Intention to Treat design, in which data for patients who disenrolled during the study were included in analyzed data.

Table 1 shows the baseline characteristics of the study participants. The average age of treatment group members was 75.2, with 24% being over the age of 80. More than half (54.3%) were female, 5.7% were non-white, and 28.6% lived alone. Variables noted

in Table 1 reflect Structural variables within Donabedian's SPO model (1966) or SPO Input variables reflecting person-level characteristics such as health conditions and chronic diseases (Holzemer, 1996).

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Table 1

Summary of Selected MCCD Patient Characteristics

Demographic or clinical variable	Parameter mean or % (n)
Age	
Age > 80 years	24%
Median age	75.2
Gender	
Female	54.3%
Male	45.7%
Race/Ethnicity	
White	94.3%
African American	3.7%
Other	2.0%
Education	
<High School	10.7%
Marital Status	
Not Married	38.3%
Married	61.7%

Table 1 continued

Demographic or clinical variable	Parameter mean or % (n)
Household	
Not Married	38.3%
Married	61.7%
Household	
Lives Alone	28.6%
Verified Chronic Conditions (at enrollment)	
AFib	21.5% (333)
CAD	43.5% (673)
CHF	18.0% (279)
COPD	27.2% (421)
Diabetes Mellitus	37.4% (579)
2+ verified conditions	36.1% (550)
Charlson Comorbidity index	3.2 (+-1.8)
Health Conditions	
Alzheimer's Disease	3.7% (57)
Cancer	20.5% (318)
Chronic Back Pain	29.9% (463)
Depression	18.3% (283)

Table 1 continued

Demographic or clinical variable	Parameter mean or % (n)
Eyesight Problems	17.3% (268)
Hip Fracture	3.9% (60)
Kidney Disease	4.1% (64)
Parkinson's	1.7% (26)
Stomach or Bowel Problems	26.3% (408)
Stroke	11.9% (185)
Urinary Incontinence	19.2% (298)

A few significant differences between treatment and control group members on several SPO Input variables were documented in baseline outcome research completed by Carle MCCD staff at the beginning of the MCCD (Schrader, 2006). In the domain of measured Activities of Daily Living (ADLS), the treatment group had a statistically significant lower percentage of limitations in the dressing and toileting dimensions than the control group, as well as a lower use of home Oxygen (as of January 2006). The most common reason for patient disenrollment from the MCCD was death or permanent transfer to a Skilled Nursing Facility (SNF).

In instances in this study in which patient admission subgroups are compared, subgroup numbers vary depending on the focus of the comparison. For example, the number of patients falling into the one inpatient admission group is larger compared to

the group of patients in the 1-2 inpatient admission group. The number of patients in each of the ED or inpatient admission frequency strata will be lower that the total number of patients (1551) in the study population.

RN (Nurse) Case Managers

RN Case Managers worked for Carle Healthcare System-owned primary care clinics or affiliated primary care practice organizations. Approximately 20 Carle MCCD RN case managers and trained case management assistants were/are located in the 10 practice locations, and these team members received training in chronic care assessment and monitoring protocols, use of standardized order sets, and data collection documentation using standard data collection tools and templates.

Carle Care Coordination Teams

Carle's MCCD intervention provided a combination of care coordination and disease management services by primary care teams composed of primary care physicians or mid-level providers (PCPs), nurse care managers, case management assistants (non-RNs), Advanced Practice RNs, and patients. These teams functioned as the core structural components of Carle's MCCD Care Coordination Model, in which medical care is integrated with nursing care, and in which chronic care was delivered within the context of an individualized care plan that PCPS, RNs, and patients approved. Using this collaborative process, the Carle Care Coordination Model embodied the Prepared Team and Activated Patient components of the Chronic Care Model (Figure I). Other important elements of the MCCD design reflected the Chronic Care Model structural elements of Self-Management Support (disease, medication, and self-care education), Decision Support (protocol-guided, evidence-based chronic disease care),

Delivery System Design (care coordination model with experiences RNs) and Clinical Information System (case management information system and electronic medical record) elements.

RN Case Management Activities

Within one month of MCCD enrollment, patients completed an initial questionnaire and nursing assessment, from which a plan of care was developed, incorporating patient, PCP and RN Case Managers' care goals and activities. Treatment group patients received RN case management continuously during their enrollment and this involved an average of about 12 nurse contacts annually. More frequent contact with patients occurred depending on assessment–driven acuity level of patients or in the presence of changes in health status. Telephone, in-person office visits, written letters to patients, home visits, and hospital /SNF visits were used to contact/interact with patients/caregivers. Contact was mandated in the presence of ED, inpatient, and /or SNF admission or if the patient's condition warranted contact. Annually, case managers and patients completed a comprehensive health assessment addressing a number of questions regarding health services utilization, medications, physical signs and symptoms, and activities of daily living. Information from the annual assessment was incorporated into the patient's individual care plan.

The Carle MCCD Care Coordination Model included collaborative team conferences with PCPS, RN Case Managers (Nurse Partners), Advance Practice RNs, and patients. MCCD case managers communicated with PCPs and other clinicians typically through telephone, secure email or in-person contact. Selected nursing assessment

information and some care plan-related information were communicated to PCPs through entry of the information into the patient's Electronic Medical Record (EMR). Case managers documented the care and treatment plan in electronic format in the MCCD Case Management Information System (CMIS) to facilitate communication across care settings and ease revision of care plans. Care coordination interventions in the plan related to diagnoses and identified problems. The finalized care plan was shared with the patient verbally and/ or in the format of a care plan letter, and was maintained in the CMIS, which generated "to do" lists, and electronic and paper versions of the plan.

In the Carle Clinic MCCD program, clinical measurement activities included the monitoring of diagnostic laboratory tests such as Hemoglobin A1C, lipid panels, and fasting blood sugars, as well as annual and periodic preventive screenings completed by participants. Per-Member-Per -Month costs associated with ED, acute inpatient, and post acute care hospitalization were analyzed to track site expenditures and to assess whether expenditures met budget neutrality goals established for the MCCD. RN case management activities and contacts with treatment group patients, families, other care providers, and support service providers were documented in reporting format of standardized nursing assessment and intervention categories as well as in free text contact record entries. The nursing activity classification scheme used for nursing assessment was based on the Omaha Classification scheme, which is an orderly, non-exhaustive, mutually exclusive, client-focused taxonomy used by nurses and other health care professionals to classify patient needs and strengths in a number of dimensions (Omaha System, 2002). The four domains (environmental, psychosocial, physiological and health

behaviors) comprise the first level of the taxonomy and represent priority areas of professional and client health-related concerns.

Nursing Intervention Classification (NIC) categories were utilized to capture nursing intervention time and activities in the MCCD case management information system (CMIS). NIC categories are nursing discipline-specific classifications of healthcare interventions (Henry, Holzemer, Randel, Hsieh, & Miler, 1997). The categories used in the MCCD were : assessment, identification of health services and personal care/other service needs, arranging health services and personal care/other services, explaining medications, tests, and treatments, providing emotional support, monitoring of services/other, routine monitoring, and documentation This RN intervention/ encounter data is the primary source of data for this study.

Care Coordination/Disease Management Protocols

Evidence-based chronic disease management protocols were used for MCCD participating physicians and RN case managers for each chronic disease (i.e., Atrial Fibrillation, Coronary Artery Disease) to guide clinical assessment, care planning, treatment and care documentation. These protocols reflected consensus guidelines from the American Heart Association, American Diabetes Association, the Centers for Disease Control, or treatment guidelines published in peer-reviewed clinical journals, and were adapted for use in the Carle Clinic system and MCCD. Customizable order sets were available for the inclusion diagnoses of Atrial Fib, CAD, COPD, Asthma, Diabetes and CHF. These order sets addressed clinical monitoring activities, self-care goals, basic monitoring laboratory frequencies, patient education goals, and alert conditions and lab

values for physician contact. The case managers also were guided by standing order sets for specific chronic conditions, which addressed periodic clinical laboratory monitoring screening goals. Case managers had access to written patient care education materials specific to the chronic diseases and also relating to self-care activities. Each full- time case manager had a case load of up to 135 MCCD patients, and minimum contact frequencies for initial and ongoing care were established, with a minimum of monthly contact during the first year of patient participation, with patient health status and needs dictating more frequent contact. Quarterly contact periods were adopted in subsequent years of the RCT for patients who needed only routine monitoring and support if their health permitted longer contact periods.

Clinical Information Systems

In addition to the CMIS that was used for recording and sharing care coordination information among clinicians, a Clinical Alerts System was used to identify patients who needed assistance with the management of complex health conditions throughout the care continuum. The Clinical Alerts System enhanced identification of MCCD participants who were at risk for fragmented care and inappropriate utilization across intervention sites. The Clinical Alerts System supported a referral process to improve communication across settings, levels of care, and departments by formalizing linkages among and between internal and external providers and services. The system contained established procedures for timely and effective transitional care planning and provider follow-up during acute hospitalization, and upon hospital discharge to extended care, home care, or ambulatory and outpatient care.

Measures

The Donabedian structure-process-outcome (SPO) model of quality care, modified to include antecedent and input variables (Holzemer, 1994), serves as a basis for the Chronic Care Model (CCM). The CCM (Figure 1/Figure 2) in turn guides the identification/selection of indicators available in the data set and their application in the analyses completed for this study. Structural and process variables used for this analysis include:

1. Patient demographic features (structural variables) of age, gender, race, city of residence (urban versus rural)

2. Patient diagnosis variables (structural/antecedent variables): primary admitting diagnoses and pre-existing chronic disease diagnoses, number of comordid conditions

3. Case Manager activities (process variables): number, combination of, frequency, and timing of RN case management activities in 21 baseline activity categories predefined and utilized in the primary RCT

4. Case Management time (amount of time in minutes, half-hour or hour increments) per selected category (can be either a process or outcome variable, depending on the analysis)[2]

5. Case Manager characteristics (structural variables): RN Case Manager identification and practice locations, representing links to patients and identified practices

6. Utilization measures (outcome variables): ED and inpatient utilization, utilization rates over four years, dates of admission, readmission

Statistical Methods

Several statistical and analytic techniques were used to support research aims. Descriptive statistics were employed to describe demographic features of the study

[2] There are no known validated measures of standardized RN chronic care case management intervention times or "doses"

patient population in the aggregate and then in specific demographic or clinical strata used for specific analyses. Mann -Whitney non-parametric test analysis, univariate and multivariate logistic regression and Cox Proportional Hazards modeling were used to test the association of patient demographics, case manager and case management characteristics with inpatient or Emergency Department (ED) admission frequency, with risk of ED or inpatient admission and with the risk of inpatient readmission. The rationale for use of these methods is described in the following sections.

Descriptive Statistics

Mean and median statistics and percentage parameters for patient demographic characteristics and case manager time, means and medians and distributions were calculated in order to characterize demographic and case management features.

Mann-Whitney Test Analysis

Mann-Whitney tests were utilized to compare median case management times among treatment subgroups experiencing different inpatient admission frequencies. This non-parametric ranking test was used to document the presence of a significant difference in median case management time for case management activity categories between the groups. The comparisons of mean/median pre and post index admission case management times for the 1 versus 2+ admission groups were also analyzed with Mann-Whitney ranking tests. The Mann-Whitney test is used for analyses of unpaired group comparisons; hospital readmissions among chronically ill older adults would not be considered to have a normal distribution, thus a non parametric statistical analysis would be indicated.

Cox Proportional Hazards Modeling

ED and inpatient admission hazard was calculated for MCCD patients within specific chronic disease categories. The purpose of these analyses was to document and compare admission hazards and time to admission (the event) among MCCD patient subgroups. The hazard odds are useful for understanding and estimating admission risk associated with specific chronic diseases, and constructing comparative survival curves.

Univariate and Multivariate Logistic Regression

Univariate logistic regression analysis was used in the initial stages of admission and readmission risk model building to separately analyze the association of patient demographic variables, individual RNs, and case management activity with ED and inpatient and readmission risk. Multivariate logistic regression was employed for the purpose of calculating readmission risk for patients with specific primary chronic diseases, selected demographic and patient clinical variables, case management time, case management activity and case manager IDs. Logistic regression is used in the presence of a dichotomous outcome variable (i.e., admission versus no admission; 1 admission versus 2+ admissions), since no assumption of normal distribution can be made with the use of a no/yes event outcome.

RESULTS

The primary aim of this study was to describe the type, timing and amount of RN case management interventions and to identify which aspects of these interventions that are/were associated with reducing all-cause ED use and inpatient hospitalizations, focusing on inpatient readmissions. In support of these aims, description of patient demographic and selected clinical characteristics and features of RN case management structural and process variables were first completed. These data were also then utilized in non-parametric, univariate and multivariate analyses to estimate ED admission hazard, inpatient admission hazard, and inpatient readmission risk. These results are presented in the following sections.

Descriptive Analysis

Research Questions 1 and 2

The first stage of analysis in this study involved describing patient and case management characteristics, representing structural and process features of the Donabedian and Chronic Care models. Descriptive statistics reflecting patient demographic characteristics have been previously described in Table 1 and are discussed in detail in the Methods section. Patient demographic characteristics were analyzed for the purpose of determining the age, gender, race/ethnicity /other parameters within the MCCD sample. These characteristics are important in interpreting ED and inpatient admission rates and admission risk, as well as gauging the complexity of care coordination demands placed on nurse case managers.

Descriptive Summary of the MCCD Study Population

Disease and Demographic Characteristics

CAD, Diabetes and COPD were the most common verified chronic conditions in the study population, followed by Atrial Fib and CHF. Two-thirds were married, and 28% lived alone. All but six percent were white, approximately one fourth were over 80 years of age, and average age was 75 years. Approximately 60% lived in rural zip code areas, and 90% were high school graduates or greater. In addition to the MCCD-qualifying primary chronic disease diagnoses, other common diagnoses were hyperlipidemia (37%) and hypertension (42%). Other commonly documented health conditions included chronic back pain (30%), stomach/bowel disease (26%), cancer (20%), urinary incontinence (19%), depression (18%), eyesight problems (17%), and stroke (12%).

Chronic Disease Characteristics. MCCD patients had a mean of 4.5 chronic and acute diseases verified and documented in the MCCD data base (excerpt, Table 2). Top chronic disease diagnoses included Hypertension, other cardiovascular diseases, lung diseases, and Diabetes Type 2. Chronic/debilitating neurologic disorders were less commonly found in the patient population, in part because cognitive impairment diagnoses, if known, were excluded in the MCCD RCT design.

Table 2

Most Frequently Documented MCCD Treatment Group Chronic Disease Diagnoses

Diagnosis	ICD_9 CM Code	Frequency	Percent of patients
Hypertension	401.9	649	41.87
Diabetes Type 2, Uncomplicated	250.00, 250.02	581	37.48
Diabetes Type 1/2 with Complications	250.40-250.92	41	2.64
Chronic Ischemic Heart Disease	414.8, 414.9	575	37.09
Hyperlipidemia	272.4	566	36.51
Emphysema/Asthma/COPD	492.8,493.1, 493.1, 493.2, 493.9, 494.0, 496	533	34.38
Atrial Fibrillation	427.31	374	24.12
Congestive Heart Failure	428.0	295	19.03
Coronary Arteriosclerosis	414.00-414.05	205	13.22
Hypothyroidism	244.9	131	8.45
Hypertensive Heart Disease, no CHF	402.90	114	7.35
Depressive Disorder	311.0	111	7.16

Inpatient Services Utilization

Research Question 3

A frequency distribution of inpatient admissions for treatment group patients during the four year study period was completed to document the admission frequency of MCCD patients. Admission frequency in an older adult, chronically ill population can be impacted by care coordination and chronic disease management processes, and therefore can be one useful patient outcome indicator. Admission frequency in the MCCD population was calculated to establish the observed admission rate and to compare this to an expected rate of admission. A total of 1, 777 admissions were generated by 768 MCCD patients for the 2002 to 2005 period (Table 3). The adjusted admission rate for the group was calculated at 0.0428 inpatient admissions per month and 0.0189 ER admissions per month, based on 41, 345 total exposure months and 1771 inpatient admissions and 783 ED admissions for the study period. The expected acute inpatient admission rate for a 65 year old+ age group with an average of 2 chronic conditions for the period would be 450 inpatient admissions/per 1,000 65+ /year (National Center for Health Statistics [NCHS], Aging Statistics, 2007). In 2006, 24.5 % of adults 65 and over experienced one or more ED visits, compared to 18.4 % of adult aged 45-64 years of age (NCHS, 2007). The expected annual ED visit rate for the MCCD population would be a minimum of 240/1,000 people/year, or 1,440 visits for the four year study period. During the 2002-2005 period, MCCD treatment group patients experienced 300 inpatient admissions/1,000 patients/year. Sixty nine percent (n=536) of MCCD patients experiencing inpatient admissions had two or fewer admissions during the four year period, and eighty percent (n=630) of those admitted had three or fewer admissions. Seven percent of patients had six or more admissions during the treatment period (Table

3). Fifty percent of treatment group patients (n=783) had no documented inpatient admissions during the four year study period.

Table 3

MCCD Treatment Group Inpatient Admission Frequency Table, 2002-2005

Admission category	Total number of MCCD patients per admission category- 2002-2005	Percent of all persons admitted per admission frequency category
1 Admission	339	44
2 Admissions	197	25
3 Admissions	94	12
4 Admissions	58	8
5+ Admission (5-14 Admissions)	80	11
Sum	768 Patients	100%

Case Management Time Allocations

Research Questions 4 and 5

Case management activity categories and time allocated to these discrete activities comprise two kinds of process variables evaluated in this study. These variables are documented descriptively here and also later employed as independent variables in univariate and multivariate analyses. Case management processes reflect the dimension of "process" within Donabedian's SPO model, and the evidence-based care processes in the Chronic Care Model. An analysis of the mean amount of time, in minutes of RN time, documented for each of the case management categories, was conducted in a series of

frequency, mean and variance calculations. The purpose of this segment of the analysis was to describe the average amounts of case management time allocated to each person in the treatment group over the four year study period, representing total time/activity category across patient exposure months (Table 4).

The case management assessment and intervention activity categories utilized in the MCCD are common nursing assessment and intervention categories found in established Nursing Intervention Classification (NIC) schema, as described in the Methods section. These activity classification categories were defined within the MCCD policies and procedures on which RN Case Managers were trained and that guided MCCD documentation. Data collection templates segmented by activity category were used by RNs to collect time and activity information for program evaluation purposes. The MCCD Assessment category of activity included the initial and annual assessments completed for patients, as well as assessments that occurred within the context of ongoing monitoring. Identify Needs activities occurred in both the initial and ongoing assessments, and Arrange Services, Monitor activities, Explain educational activities and Emotional Support occurred after initial assessments, periodic assessments, and in relationship to symptom and health status changes, or case management/ primary care interventions.

Average Case Management Time Documented per Patient/Month per Category

Patients received an average of 60 minutes/month in RN case management time distributed among the 21 case management categories, adjusted for patient enrollment months. Case management activity category 21, Intake, had few minutes documented (average 0.02 minutes/patient), and for this reason it was not utilized in further analyses

in this study. Documentation was the largest category of RNs' case management time, averaging 26 minutes a month and accounting for 43% of mean monthly case management minutes. The second most common single activity was the Assessment category, as noted previously, which was used by MCCD RNs to capture initial enrollment assessment, periodic assessments, and problem-focused nursing assessment of patients' functional, clinical and psychosocial indicators. Routine monitoring (Monitor: Routine) was the third most commonly documented case management activity. The fourth and fifth most frequently documented individual time categories were Explain: Disease/Self-Care and Explain: Medications/Treatments, involving teaching and counseling of patients (and caregivers) regarding diagnostic evaluation results, symptom management, and medication management and treatments. As a whole, the Educate categories comprised the largest direct service case management category. Time allocated to arranging a variety of health and support services (Arrange Services) were the next most common combined case management time category, followed by the combined Identify Needs category and then Patient-Specific Travel, reflecting travel time to patients' home, or hospital or office visit sites. The Emotional Support activity comprised approximately 2% of monthly case management time.

Table 4

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RN Mean Case Management Contact Minute Distribution/Month/4 Years

RN Case management	Mean minutes/activity/month activity type	SD	Percent of total minutes
1. Assess	7.06	32.04	12.0
2. Identify Needs: Personal Care	0.22	1.66	.004

Table 4 continued

RN Case management	Mean minutes/activity/month SD activity type		Percent of total minutes
3. Identify Needs: Transportation	0.16	1.17	.003
4. Identify Needs: Other-Non-Medicare	1.16	5.32	2.0
5. Identify Needs: Medicare	1.44	6.35	2.5
6. Arrange Service: Personal Care	0.20	3.30	003
7. Arrange Services: Transportation	0.10	0.97	.002
8. Arrange Services: Other Non-Mcare	2.21	9.87	4.0
9. Arrange Service: Medicare	1.61	7.32	3.0
10. Explain: Disease/Self-Care	3.68	16.42	6.0
11. Explain: Labs/Tests	1.93	8.99	3.0
12. Explain: Medications/Treatment	2.56	12.03	4.0
13. Explain: Other	0.87	4.62	1.0
14. Monitor: Routine	5.74	25.84	10.0
15. Monitor: Services	0.60	3.41	1.0
16. Monitor: Abnormal Results	0.49	3.03	1.0
17. Monitor: Other	0.61	3.56	2.0
18. Emotional Support	1.34	6.65	2.25
19. Patient-Specific Travel	2.25	13.52	3.75
20: Document	25.79	106.62	43.0
Total	60.02		

Minute and Percent Distribution of Combined Functional Categories

For descriptive purposes here and because of the small minute values of some activities, case management activity categories within each functional activity category were combined to allow comparative analysis of case management time in primary functional categories. These major categories are: Assessment, Identify: Needs, Arrange Services, Monitor, Emotional Support, Patient-Specific Travel and Documentation. The collapsed categories allow for the depiction of related case management categories within the MCCD data. In subsequent analyses, collapsed functional activity categories are also used in logistic regression model building for readmission risk estimation. Descriptive results are shown in Table 5 and Figure 3. Direct care coordination, patient monitoring, patient education (Explain) and emotional support accounted for 39% of RN time, amounting to a mean of 23 minutes a month /patient and 4.7 hours a year/patient. Documentation accounts for an additional 42% of RN time or 26 minutes a month/patient and 5 hours a year/patient.

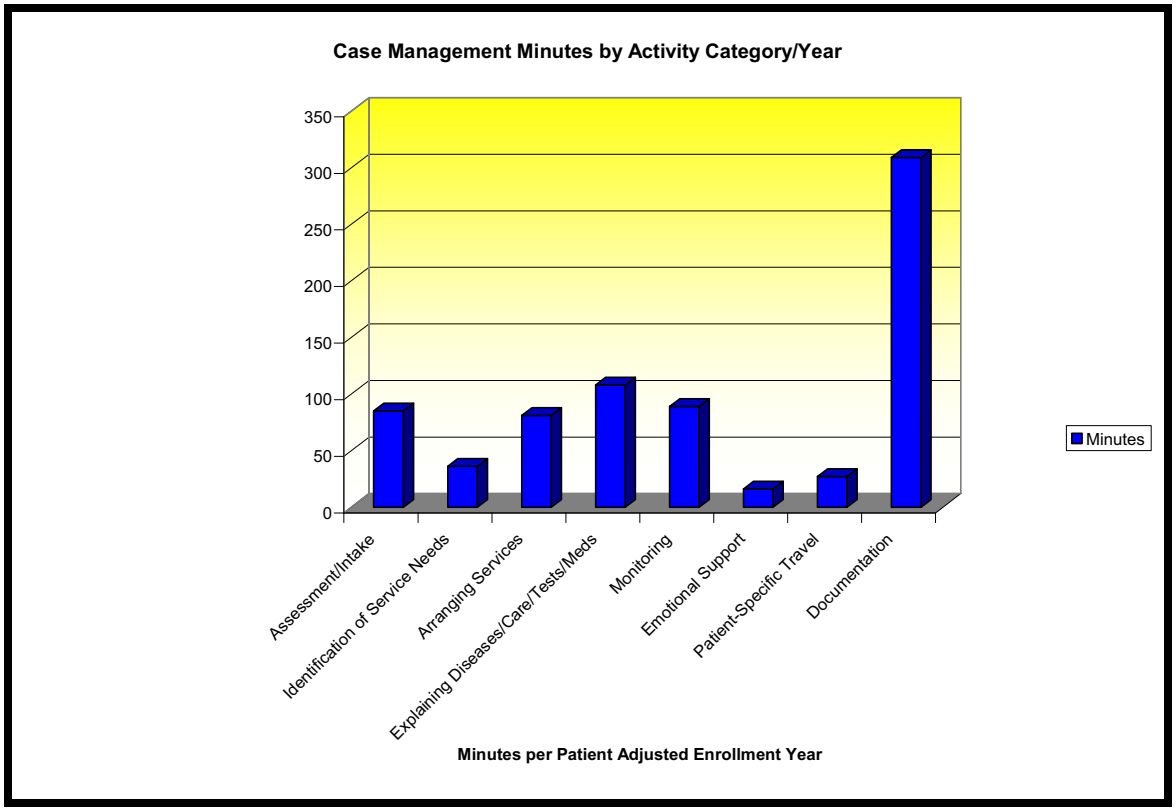
Table 5

Mean Minutes of RN Case Management per Functional Category per Patient/Year

Case management activity	Percent of mean minutes	Mean minutes/patient/year
Document	42.0	309
Assess	11.1	85
Identify Needs	4.8	36
Arranging Services	10.1	81

Table 2 continued

Case management activity	Percent of mean minutes	Mean minutes/patient/year
Explaining Diseases/Self[3]	14.4	108
Monitoring	11.9	89
Emotional Support	2.1	16
Patient-Specific Travel	3.6	27
Sum	100.0	751



[3] Note. Explain Diseases/=Explain Diseases/Self-Care/Tests.

Figure 4. Mean minutes for RN case management activity per functional category per patient adjusted year

Identification of Variables Associated with Admission and Readmission

Research Questions 3, 4, 6, 7 and 9

The primary research question guiding this analysis was: Which case management interventions were associated with patients' admission and readmission risk for the acute inpatient setting and for admission risk for the ED setting? Specifically, which case management activities in what time amounts were most relevant in reducing readmission risk? Secondly, which demographic or clinical patient-level variables were associated with admission and readmission risk? These analyses were all completed to determine which variables were the most significantly associated with the reduction of admission and readmission risk.

Non-parametric, univariate and multivariate statistical techniques were utilized to answer the research questions 3, 4, 6, 7 and 9. Admission group comparisons were completed first to identify case management means/medians between subgroups that experienced different inpatient admission frequencies over the study period. Cox modeling was then completed to answer research questions 3, 4, 6 and 9, to identify which patient characteristics and which of the 20 case management categories increased (or decreased) time to ED admission and time to inpatient admission. Univariate and multivariate logistic regression analysis was then conducted to answer research questions 7, 8, 9 and 10, to identify the best patient, clinical and case management variable predictors of inpatient readmission. Non-parametric analyses (Mann-Whitney test) were

conducted to analyze variations in amounts of case management time both pre and post index admissions to determine significant case management "dosing" differences in the 1 admission versus 2+ admission groups. ANOVA analyses of contact time interval differences for admitted patients were conducted to determine significant case management dosing and timing amounts (research question 10). ANOVA analyses were also employed to assess potential differences in allocation of primary chronic disease types (research question 8) among case managers.

Case Management Differences Among Patient Subgroups

Inpatient Admission Frequency Group Comparisons

Ranked mean analysis (Mann-Whitney test) was completed for time allocated in case management activity categories for patients experiencing one or more inpatient admissions during the study period. This analysis involved three different comparison groups and a dichotomous outcome variable of no admission versus 1 admission, no admission versus 1 or 2 admissions, and 0 to 2 admissions versus 3+ admissions. A total of 84 comparisons were completed (not shown). These different analyses were completed to determine if case management time differed among patient groups with different admission frequencies. The mean minutes of case management time for patients in each of the comparison groups are the subject of the comparison and Mann-Whitney calculations. Statistical significance was defined in this analysis as a p value of < than .10, though study results are reported within the $p < .05$ and $p > .05$ to $< .10$ categories. The alpha of .10 was selected rather than a more conservative .05 or .025 because of the exploratory nature of this study. Admission group comparisons that were found to be significant in individual case management activity categories are displayed in Table 6. In

the table/comparisons, patient numbers in comparisons differ depending on the specific admission frequency groups being compared.

Patients with two or fewer admissions compared to patients with three or more admissions. There were no case management category comparisons that were statistically significant at the $p<.05$ level. One case management category was significant at $p=.088$, with patients experiencing 2 or fewer admissions during the four year period receiving slightly more (one minute) case management time in the Arrange Services: Personal Care category (Table 6), compared to patients with 3+ admissions. This activity category reflects the coordination of personal care services for patients in need of physical care or homemaker services.

Patients with no admissions compared to patients with one or two admissions. In one of 20 case management categories, there was a statistically significant difference in the category of Identify Needs: Medicare between patients with no admissions during the four year period and those patients with one or two admissions ($p=.013$, Table 6). Patients who had no admissions received on average 4.3 minutes more case management intervention time in this category (53 minutes/4 years versus 49 minutes/4 years). Identify Needs: Medicare reflects a Medicare-coverable service need identified during a patient contact or contact with a provider or other person, related to a specific new or previous problem. This activity may include identification of the need for additional assessment or other RN or Case Management Aid assistance and can include case management time focused on identifying health services needs such as primary care, pharmacy services, or home health service. The activity can also reflect the care management activities and communication occurring between patients, caregivers, and

primary care providers and institutional organizations such as hospitals, clinical laboratories, imaging providers, inpatient and outpatient rehab providers, and pharmacies. A second case management category of Monitor: Other, was significant at the p=.067 level, with patients in the no admission group receiving approximately 10% more time on average than patients with 1 to 2 admissions. This activity category reflects monitoring activities not directly related to the monitoring of abnormal clinical diagnostic findings, routine monitoring or service monitoring.

Table 6

Case Management Categories Associated with Difference(s) in Admission Frequency

Activity and Admission Group	*n*	*Mean (Median) minutes*	*SD*	*Median*	*CI Upper*	*CI Lower*	*p*
Arrange Services: Personal Care							
0 to 2 Admissions	379	9.76 (5.0)	10.36	5.0	5.0		.088
vs.							
3+ Admission	62	8.87 (5.0)	9.30	5.0	5.0		
Identify Needs: Medicare							
0 Admissions	732	52.82 (35.76)	45.0	45.0	50.0		.084
1+ Admissions	723	49.94 (35.20)	40.0	40.0	45.0		
Identify Needs: Medicare							
0 Admission	732	52.82 (35.76)	45.0	45.0	50.0		.013
1-2 Admissions	508	48.55 (40.00)	34.76	40.0	45.0		

Table 6 continued

Activity and Admission Group	*n*	*Mean (Median) minutes*	*SD*	*Median CI Upper*	*CI Lower*	*p*
Arrange Services: Medicare						
1 Admission	156	7.93 (6.74)	4.72	2.97	21.43	.054
2+ Admissions	567	3.36 (1.80)	3.04	1.79	6.59	
Monitor: Other						
0 Admission	732	52.82 (45.0)	35.76	45.0	50.0	.067
1-2 Admissions	508	48.55 (40.0)	34.76	40.0	45.0	

Patients with no admissions versus patients with 1+ admission. There were no case management categories that were statistically significant at the p<.05 level. One case management category was significant at the p=.084 level (Table 6), Identify Needs: Medicare, in which patients in the no admission subgroup received on average slightly more time (three minutes) than did patients experiencing one or more admissions; this is the same case management activity category that was significant (p=.013) in the no admission versus 1-2 admission comparison analysis described previously.

Patients with 0-2 admissions versus those with 3+ admissions. Patients with 2 or fewer admissions received slightly more time (one minute) on average than patients with 3+ inpatient admissions (p=.0888) in the Arrange Services: Personal Care category. The

Standard Deviation (SD) of this activity category, representing deviation of 9-10 minutes from the mean, exhibited a similar difference of one minute between the 0-2 versus 3+ admission subgroups.

Overall, these findings suggest slight differences between admission group strata in the amount of mean case management time targeted to identifying and arranging Medicare service needs, monitoring, and arranging personal care services. The findings also suggest that the differences among outcome groups need further analysis in multiple regression risk prediction models.

Admission and Readmission Risk Predictors

Research Question 4

Univariate and multivariate logistic regression analyses, and Cox Proportional Hazards modeling were conducted for the purpose of defining risk for all-cause inpatient and all-cause ED admissions and all cause inpatient readmissions. The admission and readmission outcomes were analyzed separately because the risk of admission and associated predictor variables may differ from predictors/risk of readmission. The results are summarized in the following sections.

Hazard Estimation for ED Admission

Case Management Activity Predictor Variables/ED Admission Outcome Analyses

Research Questions 3, 4, 5 and 9

Cox Proportional Hazards modeling was employed to analyze the association of type of case management activity (20 categories, independent variable) and time to/hazard of ED admission. The purpose of the analysis was to identify case management activities that are associated with increased (or decreased) time to ED admission

(survival). The 20 case management categories were each utilized as an independent variable in 20 separate Cox models, with ED admission serving as the dependent variable. The results of these analyses are displayed in Table 7.

Only one activity category, Monitor: Services (Table 7), was significantly associated with ED admission hazard (p=.009). For each additional minute of monitoring services provided (anytime), the hazard odds of ED admission increases 10.9%. This case management activity category includes monitoring of personal care services and health services that a patient is receiving, and can reflect higher patient acuity, ADL challenges, complex care routines, or personal care issues.

A number of diagnoses (NDx) independent variable was added as a second independent variable to the 20 separate Cox models listed in Table 7, again with ED admission serving as the dependent variable. This variable was added to control for patient acuity and co-morbidity in the estimation of ED admission hazard. This analysis resulted in statistical significance (p<.05) of NDx within 19 of 20 case management categories (Table 8). ED admission hazard odds were found to increase 3.7% to 8.0% for each additional patient diagnosis added to the model. In combination with the variable NDx in a model, the Arrange Services: Personal Care category, was not predictive of ED admission (p=.13). This suggests that factors/variables other than NDx influenced case management time spent on Arrange Services: Personal Care and associated readmission risk. Three monitoring activity categories were significantly associated with increased ED admission hazard: Monitor: Services (p=.09), Monitor: Abnormal Lab/Tests (p=.003), and Monitor: Routine (p=.04), with hazard ratios ranging from 1.022 to 1.113 (Table 8).

Table 8

ED Admission Hazard, Cox Proportional Hazards Model, with Case Management Category and Number of Diagnoses Independent Variables, ED Admission as Outcome Variable

Table 8.

ED Admission Hazard, Cox Proportional Hazards Model, with Case Management Category and Number of Diagnoses Independent Variables, ED Admission as Outcome Variable

Case management activity	Total n	Event	Censored	Activity hazard ratio/p	Actvity NDx/p
Assess	783	200	583	1.005/.31	1.007/.0001
Identify Needs: Pers.C[4]	783	181	602	0.937/.21	1.076/.0003
Identify Needs: Transp.	783	167	616	0.908/.30	1.077/.0007
Identify: Needs Oth.Non	783	192	591	1.029/.33	1.071/.0006
Identify Needs: Medicare	783	192	591	1.021/.41	1.078/.0002

Table 8 continued

Case management activity	Total n	Event	Censored	Activity hazard ratio/p	Actvity NDx/p
Arrange Services: Pers.C	783	148	635	1.007/.68	1.037/.13
Arrange Services: Trans.	783	204	579	0.985/.72	1.072/.0003
Arrange Services: Oth.	783	193	590	0.987/.61	1.076/.0002
Arrange Services: Medi.	783	195	588	1.004/.87	1.068/.0012

[4] Note. Pers. C=Personal Care. Oth.Non=Other Non-Medicare. Oth.=Other Non-Medicare. Medi.=Medicare. Diseases/Self=Diseases/Self-Care. Meds/Treat.=Medications/Treatment. Abnorm.=Abnormal

Explain: Diseases/Self	783	204	579	1.020/.14	1.076/.0001
Explain: Lab/Tests	783	197	586	1.032/.26	1.075/.0002
Explain: Meds/Treat.	783	201	582	1.004/.84	1.078/.0001
Explain: Other	783	194	589	0.0975/.40	1.073/.0002
Monitor: Routine	783	205	578	1.022/.09	1.076/.0002
Monitor: Services	783	142	621	1.113/.003	1.074/.0015
Monitor: Abnorm.	783	188	595	1.034/.04	1.073/.0006
Monitor: Other	783	190	593	1.024/.39	1.076/.0004
Emotional Support	783	188	595	1.016/.33	1.080/.0002
Patient Specific Travel	783	189	595	1.002/.53	1.075/.0003
Document	783	205	578	1.008/.13	1.074/.003

A third Cox model analysis of ED admission survival was conducted, adding an interaction term of Time*NDx to the 20 individual models containing the case management activity category and number of diagnoses independent variables. The purpose of including an interaction term in the Cox model building process was to determine if patient acuity or risk, reflected in the multiplicity of comorbid conditions, might have influenced the amount of time case managers allocated to patients. Assessing the influence of multiple diagnoses on admission risk is important in the comparison of healthcare outcomes of groups affected by differing numbers of comorbid conditions (Desai, Bogardus, Williams, Vitagliano, & Inouye, 2002). In the Cox analyses, one Time* NDx interaction term variable was found to be significant (p=.016, OR=1.008) in association with the case management activity of Arrange Services: Personal Care (Table 9). This indicates that the RN time allocated to activities involving arranging personal

care-related services is likely influenced by the number of patient diagnoses, an indicator of patient acuity and/or risk. This is an important consideration in designing RN case management programs and allocating resources to patients through risk adjustment based on numbers of diseases.

The RN time allocated to Arrange Services: Personal Care, controlling for the number of diagnoses and the Time*NDx interaction, is associated with a slight increase in ED admission hazard odds. This suggests that patient acuity, measured by number of diagnoses in this analysis, in part influences case manager time allocated within the Arranging: Personal Care category.

Table 9

Time to ED Visit, Cox Proportional Hazards Model, with Addition of Time and Number of Diagnoses Interaction Term (Total n=783)

Case management activity	Event / Cens. n	Activity HR/p	NDx*Activity HR/p	Time*Activity HR/p
Assess	200 /583	1.007/.41	1.081/.004	1.00/.77
Identify Needs: Transp.	167/616	0.663/.09	.095/.32	1.034/.08
Identify: Needs Oth. Non.	192/591	1.109/.04	1.189/.03	0.982/.20
Identify Needs: Medicare	192/591	1.109/.87	1.076/.982	1.008/.02
Arrange Services: Pers.C	148/635	0.967/.22	0.982/.59	1.008/.016
Arrange Services: Trans.	204/579	1.256/.97	2.387/.98	0.848/.98
Arrange Services: Oth.	193/591	0.975/.55	1.049/.36	1.005/.56
Arrange Services: Medi.	195/588	1.024/.58	1.083/09	0.997/.66

Table 9 continued

Case management activity		Activity	NDx*Activity	Time*Activity.
	Event n/ Censored n	HR/p	HR/p	HR/p
Explain: Diseases/Self	204/579	1.033/.13	1.108/.008	0.997/.40
Explain: Lab/Tests	197/586	1.072/.12	1.130/.03	0.992/.35
Explain: Meds/Treat.	201/582	0.995/.90	1.080/.90	1.00/.95
Explain: Other	194/589	0.944/.35	1.025/.67	1.006/.52
Monitor: Routine	205/578	1.045/.03	1.122/.002	0.996/.26
Monitor: Services	142/621	1.001/.69	1.028/.67	1.008/.47
Monitor: Abnormal	188/595	1.048/.18	1.110/06	0.993/.44
Monitor: Other	190/593	1.010/.87	1.065/.40	1.003/.82
Emotional Support	188/595	0.990/.76	1.082/.063	0.998/.09
Patient Specific Travel	189/594	1.018/.06	1.137/.0001	0.998/.09
Document	205/578	1.003/.77	1.057/.05	1.001/.45

Three other Time*NDx interaction terms were significant at a p >.05 and < .10, with 1 of 3 of these associated with increased hazard odds: Identify Needs: Transportation (OR 1.034, p=.076). This interaction may reflect time spent on complex social support activities like addressing transportation to primary care services. The interaction may also mirror patients' clinical complexity, functional capacity changes, or possibly gaps in caregiving that are expressed in transportation issues. The presence of an interaction with time and number of diagnoses suggests that NDx influences time spent in

the Identify Needs: Transportation activity. The remaining two interaction variables were associated with a decrease in hazard odds of ED admission, controlling for individual case management activity and NDx variables in the Cox model; these two interaction variables were Emotional Support (OR 0.999, p=.09) and Patient-Specific Travel (OR 0.999, p=.09). This finding indicates that case management time within these two activities had a very slight though positive impact on ED admission hazard odds, slightly increasing the time to admission (survival). For every minute of case management time in the two categories, in the presence of an additional diagnosis, hazard odds decreased by one tenth of one percent.

The case management activities of Identify Needs: Other Non-Medicare, Identify Needs: Transportation, Monitor: Routine, and Patient-Specific Travel were significant ($p < .10$) ED admission hazard predictors in each of their associated models, controlling for number of diagnoses (NDx) and the Time*NDx interaction. This finding indicates that these case management activities are associated with reduced time to ED visit and thus increased admission hazard, likely an endogenous rather than causative relationship. These activities include case managers' addressing patient needs that include personal care and other non-clinical service demands, and in-home, hospital or office-based patient visits. The NDx variable was significant ($p < .10$) in eight of the 20 individual Cox models (Table 9), reflecting the association of number of diagnoses with ED admission hazard. These NDx significant categories included Assessment, Identify Needs: Other Non-Medicare, Arrange Services: Medicare, Explain: Disease, Explain: Labs/Tests, Monitor: Routine, Patient-Specific Travel, and Documentation. This finding indicates that case manager time in these activity categories is associated with greater

numbers of diagnoses and likely greater patient acuity and complexity of care coordination, and associated greater ED admission hazard.

Chronic Disease Predictors of Time to ED Admission

Kaplan-Meier survival curves by major chronic disease category were completed for time to ED admission (Figure 4) as a component of Cox modeling and ED admission risk estimation. The survival curves display survival time, or time to the ED admission event. This analysis was completed to document the relative influence of patients' primary chronic disease on time to ED admission (survival). In a case -managed population, this risk would be important to estimate to aid in understanding patient subgroup risks and to aid in evaluating the influence of case management intervention on ED admission. The relative hazard pattern was similar to that of the inpatient survival curve (Appendix C), with CHF displaying the greatest ED admission hazard, followed by CAD and Atrial Fibrillation.

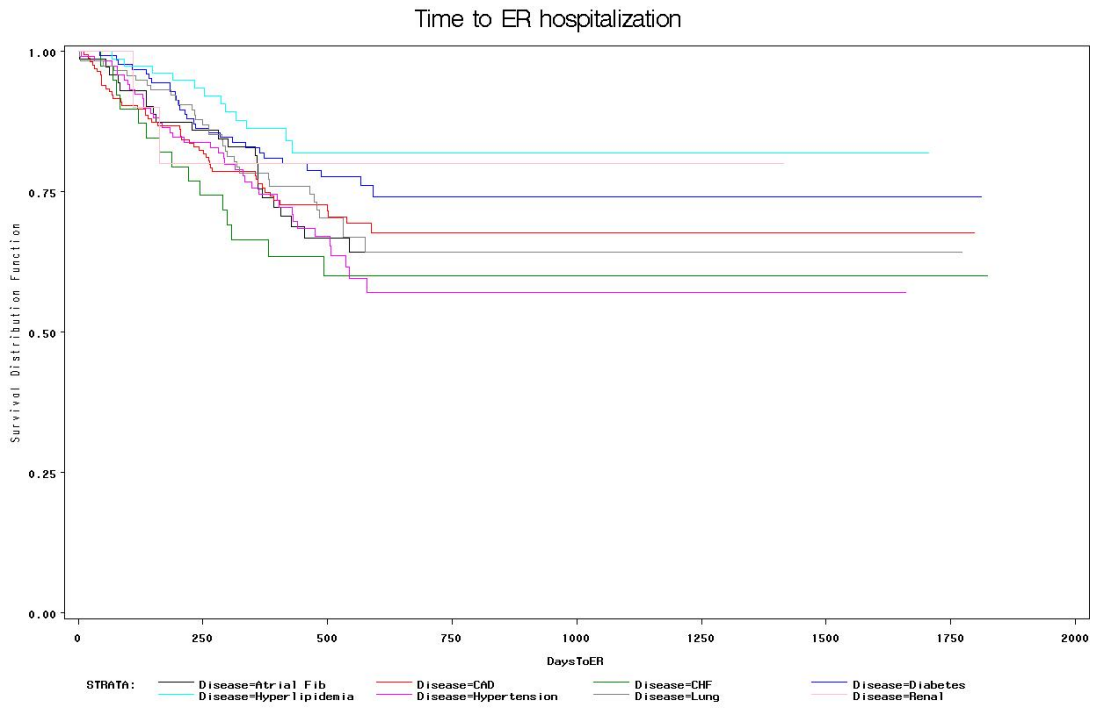


Figure 4. Emergency Department visit survival time to admission) by major chronic disease

The survival curve indicates that in this case-managed population, patients with CHF, CAD and AFib had higher for ED admission, than patients with other primary chronic disease diagnoses. There was some risk stratification of patients within MCCD, though this study did not focus on whether these patients at higher risk of ED admission were treated as high risk patients in the MCCD study. In this study, all-cause inpatient readmission risk models, rather than inpatient admission risk per se, were analyzed and are detailed in the following sections.

Inpatient Readmission Risk Estimation

Research Questions 6, 7 and 8

The Cox model analyses described in the preceding section and in Appendix C focus on all-cause ED admission hazard and inpatient admission hazard. Inpatient readmission as a patient outcome was analyzed in a separate series of analyses because structural and process variables measured in this study may impact inpatient readmission risk differently than admission risk.

Univariate and multivariate logistic regression analyses were conducted to identify associations between patient and case management variables and the dependent variable of inpatient readmission. Analyses employed patient and case manager characteristics in the form of case management timing, time (minutes), and type as independent variables and inpatient readmission (1=2+ admissions=readmission, 0= 1 admission) as the dichotomous dependent variable. In these analyses, patients with one

admission (n=168) were compared with patients with 2 or more (2+) admissions (n=260). These two patient groups were stratified as such to test whether there was a significant difference in patient or case management characteristics among patients experiencing only one "any time" admission during the four year period and those patients experiencing one or more "any time" readmission. Patient characteristics included age, gender, race/ethnicity, urban or rural residence, number of diagnoses (acute or chronic), type of primary chronic disease classification (seven total), and number of chronic diseases (patients had up to seven documented). Case management activity/time data documented by 14 RN Case Managers for all enrolled patients, linked to patient characteristics and admission histories, was analyzed in univariate and multivariate analyses described here. If case management activity, reflecting a process variable in the Chronic Care Model, offered a protective benefit for reducing readmission, a comparison between the 1 versus 2+ inpatient admission groups would be expected to reveal this in a statistical analysis of predictors of readmission outcome.

Patient Characteristics and Inpatient Readmission Risk

One univariate and seven multivariate regression models were developed and tested with selected patient and clinical indicator variables. Patient demographic variables were selected for inclusion in separate, successive models to assess whether person-level variables were associated with readmission risk. The results of these individual models are displayed in models 1 though 8 in Table 10. Patient age was tested separately as an ordinal categorical variable, in addition to a continuous age variable (in a separate model), to determine if risk varied among different older adult age groups/clusters. The cutpoints for the ordinal age variable were determined by

documenting the age range for MCCD patients and then creating four age quartiles. Patient ages ranged from 39 years to 94 years. In each of the models, readmission was defined as the outcome variable with patients with 2+ admissions comprising the readmission outcome group, Y=1, and patients with one admission represented as Y=0.

The patient-level clinical variables tested separately as independent variables included number of diagnoses, which was represented as a continuous categorical variable within a univariate readmission risk model, and then in a separate model as a categorical variable (with four levels). The diagnosis categorical variable was constructed by dividing the total number of documented/verified patient diagnoses, including a wide range of chronic and acute diseases and conditions, into ordinal quartiles. An additional patient clinical variable category, representing seven primary chronic disease categories defined/assigned in the MCCD, was tested in a separate multivariate regression model. The demographic variables of age, sex, race and urban or rural residence and the patient clinical variables represent structural variables or structural variable inputs within the Donabedian SPO model and also the Chronic Care Model.

Table 10

Univariate and Multivariate Logistic Regression Models, Risk of Inpatient Readmission with Selected Patient Variables

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 1	Y=0	Y=1		
Age (continuous)	168	260	1.0	.78

Table 10 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 2				
Age (categorical)				
39.14-71.88	45	62	1.0	reference
71.95-77.21	40	67	1.22	.49
77.23-81.78	42	65	1.12	.68
81.83-94.66	107	66	1.17	.58
Model 3				
Sex				
Female	89	143	1.0	reference
Male	79	117	0.92	.68
Model 4				
Race				
White	155	234	1.0	reference
African American	6	8	0.88	.82
Other	3	7	1.55	.43
Model 5				
Urban vs Rural[3]				
Urban (43%)	66	117	1.0	reference
Rural	102	143	1.26	.24
Model 6				
Number of Diagnoses				
NDx (continuous 1-21)	220	175	0.98	.37
Model 7				
NDx (categorical)				
1-2	47	85	1.0	reference
3-4	38	55	0.88	.42
5-7	35	46	0.73	.27
8-21	40	49	0.68	.16

Table 10 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 8				
Number of Chronic Diseases				
1	35	56	1.00	reference
2	39	56	0.85	.60
3	42	52	0.77	.36
4	25	29	0.72	.39
5	12	21	1.09	.88
6	3	15	3.10	.088
7	1	4	2.50	.42
Model 9				
Chronic Disease				
Atrial Fib	24	24	0.76	.44
CAD	45	59	1.0	reference
CHF	12	40	2.5	.015
Diabetes	16	30	1.43	.33
Lung	25	48	1.46	.23
Hyperlipidemia[3]	11	9	0.62	.33
Hypertension	24	17	0.54	.099
Renal	2	6	2.3	.32

Patients' age (continuous and ordinal categories), gender, race and urban or rural residence were not significantly associated with risk of readmission. The Number of Diagnoses (NDx) variable included in the logistic regression model was not significantly associated with readmission risk (at a $p < .10$), though number of chronic diseases, a

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

[5] Using the U.S. Department of Agriculture, defining places, in this case patient residence zip codes, as places with less than 25,000 in population

different variable set including seven different primary chronic diseases, was significant for six chronic diseases (OR 3.1, p=.088). This means that patients with six distinct chronic disease diagnoses were at higher risk for readmission than patients with 1 to 5 or 7 documented chronic diseases. Hypertension was associated with a reduced log odds of readmission (OR 0.54, p=.099). Congestive Heart Failure (CHF) was associated with increased readmission risk (OR 2.5, p=.015), a finding consistent with health services research evidence defining CHF as the most common reason for readmission of older adults. Of note is the fact than the highest number of admissions/readmissions occurred in the CAD category; this reflects the prevalence of documented CAD in the MCCD population, representing 37% of all patients, compared to 19% of all patients for CHF. Though lower in absolute numbers, patients with a primary CHF diagnosis had the highest rate of readmission in this sample, 70%. The chronic disease categories described here are included in a final multivariate model, described separately in a later section.

Table 11 displays Models 1 and 2 in which patient age and diagnosis variables are combined in separate models. The purpose of this analysis was to determine whether clinical and age variables together predicted readmission risk. Model 1 includes one Disease predictor variable with seven (Chronic Disease) levels, and one Age Group variable with four age sub group levels. Model 2 includes the Disease and Age Group variables and additional variable, a Disease*Age Group variable. In Model 1, two Disease variables were found to be associated with readmission: CHF (OR 2.5, p=.016) and Hypertension (OR .53, p= .094) controlling for Age Group. CHF is noted in Model 2 to be the disease variable associated with inpatient readmission risk (OR 4.2, p= .05), controlling for patient age group and the Disease*Age interaction. In Model 2, only one

Disease*Age Group interaction was significant at p < .10, and this was the Hyperlipidemia*78-82 Years Age Group interaction variable.

Table 11

Multivariate Logistic Regression Models with Demographic and Clinical Independent Variables, and a Readmission Outcome Variable

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 1				
Chronic Disease				
Atrial Fib	24	24	0.74	.40
CAD	45	59	1.0	reference
CHF	12	40	2.5	.016
Diabetes	16	30	1.43	.33
Lung	25	48	1.48	.22
Hyperlipidemia[3]	11	9	0.62	.33
Hypertension	24	17	0.53	.094
Renal	2	6	2.3	.33
Age Group (categorical)				
< 72	46	62	1.0	reference
72-77	36	53	1.18	.65
78-82	43	63	1.21	.51
>82	34	55	1.22	.50
Model 2				
Disease				
Atrial Fib	24	24	1.13	.87

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

[6] Using the U.S. Department of Agriculture, defining places, in this case patient residence zip codes, as places with less than 25,000 in population

Table 11 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
CAD	45	59	1.0	reference
CHF	12	40	4.20	.05
Diabetes	16	30	1.81	.38
Lung	25	48	1.70	.33
Hyperlipidemia[3]	11	9	3.40	.31
Hypertension	24	17	1.31	.86
Renal	2	6	1.13	.93
Age Group (categorical)				
< 72	46	62	1.0	reference
72-77	36	53	1.64	.38
78-82	43	63	2.40	.11
Age Group				
>82	34	55	1.44	.49
Disease*Age Group				
AFib*72-77			1.25	.83
AFib*78-82			0.47	.47
AFib*83+			0.23	.19
CHF*72-77			0.49	.48
CHF*78-82			0.45	.50
CHF*83+			0.67	.73

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

Table 11 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Diabetes*72-77			0.43	.42
Diabetes*78-82			0.35	.27
Diabetes*83+			3.8	.31
Hyperlipidemia*72-77			0.0	.99
Hyperlipidemia*78-82			0.07	.084
Hyperlipdemia*83+			0.16	.21
Hypertension*72-77			0.28	.20
Hypertension*78-82			0.24	.20
Hypertension*83+			0.24	.24
Disease*Age group continued				
Lung*72-77			1.69	.57
Lung*78-82			0.46	.37
Lung*83+			0.81	.81
Renal*72.77			1.0	reference
Renal*78*82			1.66	.79
Renal*83+			Insufficient data	

Individual Case Managers and Inpatient Readmission Risk

Fourteen separate Case Manager variables, representing individual Carle Clinic MCCD Case Managers, were each employed as an independent variable in a multivariate logistic regression model estimating inpatient readmission risk. These case manager variables reflect structural variables in the SPO/Chronic Care Model. The purpose of this analysis was to determine the presence or absence of a statistically significant association between individual case managers and readmission outcome(s) and to document between-case manager variation in patient outcomes. Before this multivariate model was tested, a descriptive and ANOVA analysis of whether case managers had statistically significantly different concentrations of chronic diseases in their case MCCD case loads was completed. The numbers of patients by primary chronic disease category assigned to specific case managers were identified and these are displayed in Table 12. A Two-Factor ANOVA analysis of case manager-CHF patient numbers revealed that there was no statistically significant difference in distribution of chronic disease numbers among the case managers analyzed (those with greater than 8 patients) for the 2002-2005 period ($p > .05$, F 1.93).

Table 12.

Number of MCCD Patients by Chronic Illness by RN Case Manager ID
2002-2005

	RN ID4	RN ID118	RN ID127	RN ID139	RN ID160	RN ID163	RN ID164	RN ID167	RN ID168	RN ID171
Chronic Disease										
AFIB	11	20	41	26	21	5	0	1	22	5
CAD	17	25	72	37	25	34	11	5	42	3

Table 12 continued

	RN ID4	RN ID118	RN ID127	RN ID139	RN ID160	RN ID163	RN ID164	RN ID167	RN ID168	RN ID171
CHF	11	3	24	14	11	11	0	1	19	2
DIABETES	10	27	62	41	24	31	3	1	34	8
HYPERTSN[8]	0	33	12	63	18	30	1	0	55	7
LUNG	4	30	46	0	16	28	0	6	29	10
RENAL	0	5	2	0	2	4	5	0	1	0

Readmission risk associated with the 14 MCCD Case Managers and their assigned patients was analyzed through multivariate logistic regression (Table 13). This analysis was conducted employing RN ID as the independent variable and "anytime" readmission as the dependent/outcome variable (1 admission =Y=0, 2+ admissions = Y=1). Four of 14 RN Case Managers had statistically significant (p= <.05) reductions in readmission risk, ranging from an 87% to a 67% reduction in log odds; another 2 of 14 RN Case Managers had significant reduction in readmission risk at a p > .05 and < .06.

Table 13

Multivariate Logistic Regression Model Predicting Inpatient Readmission Risk, by Individual Case Manager

Independent Variable 1	1 / 2+ Admission n	Odds Ratio (CI)	p	Direction
RN 4	5/27	1.00	Reference	
RN 7	1/0	0.00	-	

[8] Note. Hypertsn.=Hypertension

Table 13 continued

Independent Variable 1	1 / 2+ Admission n	Odds Ratio (CI)	p	Direction
RN 118	21/15	0.13 (.04-.42)	0.0006	Decreased
RN 127	28/56	0.37 (.13-1.07)	0.065	Decreased
RN 139	37/43	0.22 (.08-.62)	0.0042	Decreased
RN 160	22/17	0.14 (.05-.45)	0.0009	Decreased
RN 163	14/24	0.32 (.10-1.01)	0.052	Decreased
RN 164	5/8	0.30	0.10	Decreased
RN 167	2/12	1.11	0.91	
RN 168	29/38	0.24 (08-.71)	0.0095	Decreased
RN 170	0/2	-		
RN 171	1/9	1.67	0.66	
RN 174	1/6	1.11	0.93	Decreased

In all cases where patient volume > 14 patients, individual case managers had a statistically significant ($p < .10$) decreased log odds of patient readmission. These results indicate the positive impact that RN Case Managers had on readmission risk and related avoidable health services costs. These results also indicate the need for additional study of the characteristics of these case managers' interventions and what differentiated their activities and interventions from those case managers' interventions that were not associated with reduced risk of inpatient readmission.

Additional multivariate logistic regression models for estimating readmission risk were specified to include both an individual case manager variable and the seven chronic

disease variables included in previously discussed multivariate models. These models were specified for the purpose of determining readmission risk associated with each RN Case Manager while controlling for the effects of a chronic disease variable. Eleven multivariate logistic regression models were defined for each of 11 RN Case Managers who had sufficient numbers of admitted patients to analyze (>3). Each of these 11 models thus contained eight variables, one RN ID variable and seven chronic disease variables.

Of the 11 RNs, 3 RNs were significantly associated with readmission risk at a p <.05; no RNs were significantly associated with readmission risk at the p=.>05 to <.10 level. In the three significant models, CHF was also significantly associated with readmission risk (p= .009 to.03). Model results for these three RNs are provided in Table 14. Two of three RNs (ID 118, ID 160) had significantly reduced log odds of patient readmission, while one had significantly increased odds of readmission (ID 4). None of the three RNs was found in previously discussed analyses to have a significantly greater concentration of any one of the seven primary chronic disease patients. The statistically significant results concerning individual RNs reveal that RN case managers have an impact, either or positive or negative, on all-cause inpatient readmission risk, controlling for chronic disease variables in an older adult, chronically ill, community-dwelling population

Table 14

Multivariate Regression Models with Primary Chronic Disease and RN Case Manager (ID 4, ID 118, ID 160) Independent Variables, Inpatient Readmission Outcome

Table 14 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 1				
Disease				
Atrial Fib	24	24	0.72	.37
CAD	45	59	1.0	reference
CHF	12	40	2.40	.02
Diabetes	16	30	1.41	.36
Lung	25	48	1.56	.16
Hyperlipidemia[3]	11	9	0.68	.44
Hypertension	24	17	0.59	.16
Renal	2	6	2.50	.27
Nurse ID				
Nurse ID 4	5	25	3.4	.02
Model 2				
Disease				
Atrial Fib	24	24	0.75	.42
CAD	45	59	1.0	reference
CHF	12	40	2.40	.02
Diabetes	16	30	1.53	.25
Lung	25	48	1.50	.21
Hyperlipidemia[3]	11	9	0.59	.28
Hypertension	24	17	0.59	.16
Renal	2	6	3.0	.20
Nurse ID				
Nurse ID 118	21	15	0.45	.03
Model 3				

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

Table 14 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Disease				
Atrial Fib	24	24	0.82	.56
CAD	45	59	1.0	reference
CHF	12	40	2.80	.009
Diabetes	16	30	1.50	.28
Lung	25	48	1.50	.21
Hyperlipidemia[3]	11	9	0.67	.41
Hypertension	24	17	0.54	.10
Renal	2	6	2.20	.36
Nurse ID				
Nurse ID 160	34	36	0.77	.01

Analyses of Disease/RN Interactions and Inpatient Readmission Risk. Additional multivariate logistic regression model analysis was completed, building on the RN and chronic disease predictor logistic analysis described previously. Each of the subsequent 11 models included one RN ID, the seven chronic disease variables, and a disease interaction variable, Disease*Nurse ID. The purpose of this multivariate analysis was to determine whether readmission outcomes for individual RNs were influenced by an interaction with patients' primary chronic disease. The CHF independent variable in 3 of 11 multiple regression models specified for individual RN ID variables was found to be

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

significantly associated with readmission risk (RN ID 118, RN ID 160, RN ID 168) at a p <.05. Another one CHF variable in 1 of the 11 models was found to be significantly associated with readmission risk at a p of .059 (RN ID 4). The results of the five significant models are displayed in Table 15. Hypertension was a significant individual predictor (OR 0.48, p=.067) in Model 9/RN ID 127, the only other major chronic disease category outside of CHF to be individually associated with readmission risk. These individual disease significance findings indicate that the disease, controlling for the impact of individual RNs, was associated with patient readmission risk, distinct from the largely positive impact of RNs on readmission risk

There were three statistically significant RN*Disease interaction variables in two models (p .05 to .10): for CHF (OR 8.4) and Diabetes (OR 10.2) for RN ID 127, and Lung for RN ID 168 (OR .25). Unlike CHF, neither Diabetes nor Lung disease alone was significantly associated with readmission risk in the individual models. In summary, individual RNs influenced increased readmission risk in the two cases (RN ID 127) and decreased risk in one case (RN ID 168).

Table 15

*Multivariate Logistic Regression Models with Primary Chronic Disease and RN Case Managers (ID 4, ID 118, ID 127, ID 160, ID 168) and RN ID*Chronic Disease Interaction Variables, Readmission (2+ Admissions) Outcome Variable*

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 1 with Nurse ID 4 Interaction Term				
Disease				

Table 15 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Atrial Fib	24	24	0.65	.26
CAD	45	59	1.0	reference
CHF	12	40	2.10	.059
Diabetes	16	30	0.65	.38
Lung	25	48	1.50	.21
Hyperlipidemia[3]	11	9	0.65	.38
Hypertension	24	17	0.56	.13
Renal	2	6	2.40	.30
Nurse ID 4	5	25	1.58	.53
RN ID4*AFib			0.38	.32
RN ID4*CHF			0.998	.98
RNID4*Diabetes			1.46	.79
RNID4*Hyperlipdemia			1.0	-
RNID4*Hypertension			1.0	-
RN ID4*Lung			1.45	.99
RNID4*Renal			1.0	-
Model 2 with Nurse ID 118 Interaction Term Disease				
Atrial Fib	24	24	0.81	.57
CAD	45	59	1.0	reference
CHF	12	40	2.60	.014
Diabetes	16	30	1.75	.17
Lung	25	48	1.67	.13
Hyperlipidemia[3]	11	9	0.64	.36

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

[3] Hyperlipidemia, Hypertension, and Renal disease categories were not considered inclusion diagnoses in the MCCD. They are listed and included in this analysis because MCCD patients had these comorbidities.

Table 15 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Hypertension	24	17	0.65	.29
Renal	2	6	1.20	.98
Nurse ID 118			1.58	.53
RN ID118*AFib			0.37	.50
RN ID118*CHF			1.0	;
RNID 118*Diabetes			0.26	.23
RNID118*Hyperlipdemia			1.0	-
RNID118*Hypertension			0.31	.31
RNID118*Lung			0.27	.24
RNID118*Renal			0.00	.98
Model 3 with Nurse ID 160 Interaction Term				
Disease				
Atrial Fib	24	24	0.98	.95
CAD	45	59	1.0	reference
CHF	12	40	3.50	.04
Diabetes	16	30	1.47	.32
Lung	25	48	0.75	.82
Hyperlipidemia[3]	11	9	0.86	.77
Hypertension	24	17		
Renal	2	6		
Nurse ID 160			1.02	.98
RN ID160*AFib			0.13	.14
RN ID160*CHF			0.16	.12
RNID 160*Diabetes			0.76	.83
RNID 160*Hyperlipidemia			0.00	.98
RNID 160*Hypertension			0.68	.79
RNID 160*Lung			0.75	.82
RNID 160*Renal			1.0	-

Table 15 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 4 with RNID 127				
Disease				
Atrial Fib	24	24	0.77	.53
CAD	45	59	1.0	reference
CHF	12	40	1.69	.22
Diabetes	16	30	0.96	.93
Lung	25	48	1.24	.55
Hyperlipidemia[3]	11	9	0.56	.25
Hypertension	24	17	0.48	.06
Renal	2	6	1.38	.72
Nurse ID 127			0.63	.33
RN ID127*AFib			1.10	.94
RN ID127*CHF			0.84	.07
RNID 127*Diabetes			10.20	.05
RNID 127*Hyperlipidemia			1.0	-
RNID 127*Hypertension			2.30	.59
RNID 127*Lung			2.10	.33
RNID 127*Renal			1.20	.99
Disease				
Atrial Fib	24	24	0.68	.31
CAD	45	59	1.0	reference
CHF	12	40	3.1	.010
Diabetes	16	30	1.70	.19
Hyperlipidemia	11	9	0.35	.10
Hypertension	24	17	0.55	.15
Lung	25	48	1.88	.08
Renal	2	6	1.00	-
RN ID168			1.18	.74

Table 15 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
RN ID168*AFib			3.90	.28
RN ID168*CHF			0.36	.29
RN ID168*Diabetes			0.26	.22
RN ID168*Hyperlipdemia			4.8	.17
RN ID168*Hypertension			0.91	.92
RN ID 168*Lung			.25	.09
RN ID 168*Renal			1.0	-

Case Management Rate Calculation and Association with Inpatient Readmission

Research Question 9

Predictor and control variables reflecting structural aspects of the Donabedian and Chronic Care Model have been described in previous sections. In this section, process variables embodied in the timing and type of case management intervention are analyzed for association with a readmission outcome. To further understand how use of case management intervention categories and time applied by case managers might have influenced patient readmission outcomes over time, case management minutes documented in the 20 main categories for all treatment group patients over the study period were used to calculate an average base rate/calendar month. To accomplish this, the mean monthly amount of case management time (in minutes) in each of 20 categories for all patients for the 2002-2005 study period was calculated, adjusting for patient enrollment months. This monthly rate, representing a median case management dose/month over the study period, was then analyzed (Mann-Whitney test) for each of the 20 case management categories. The analysis was completed to determine if an average

monthly amount of case management time in each category was associated with readmission. In the analyses, 16 of 20 rates per activity category were statistically significantly different for patients in the one admission group, and patients in this group consistently received more time per month than patients with 2+ admissions.

Table 16

Comparison of a Monthly Rate of Case Management Between 1 and 2+ Inpatient Admission Groups

RN Case management activity type Rate (mean minutes/30 days)	1 Admission n= 236	2+ Admission n=192	p
Overall rate	27.22	16.39	*<.0001*
1. Assess	3.01	1.85	*<.0001*
2. Identify Needs: Personal Care	0.08	0.07	.29
3. Identify Needs: Transportation	0.06	0.06	.42
4. Identify Needs: Other-Non-Medicare	0.57	0.29	<.001
5. Identify Needs: Medicare	0.69	0.45	.0013
6. Arrange Service: Personal Care	0.04	0.09	.56
7. Arrange Services: Transportation	0.04	0.04	.190
8. Arrange Services: Other Non-Mcare	1.03	0.56	.0003
9. Arrange Service: Medicare	0.62	0.60	.011
10. Explain: Disease/Self-Care	1.58	0.96	.0003
11. Explain: Labs/Tests	0.86	0.55	.0006
12. Explain: Medications/Treatment	1.77	0.65	.0004

Table 16 continued

RN Case management activity type Rate (mean minutes/30 days)	1 Admission n= 236	2+ Admission n=192	p
13. Explain: Other	0.34	0.26	.030
14. Monitor: Routine	2.59	1.27	.0001
15. Monitor: Services	0.28	0.19	.022
16. Monitor: Abnormal Results	0.22	0.15	.065
17. Monitor: Other	0.27	0.19	.026
18. Emotional Support	0.73	0.31	.0035
19. Patient-Specific Travel	1.00	0.50	.0009
20. Document	11.46	7.36	.0002

The activities of identifying the need for and arranging personal care services, as well as arranging transportation are insignificant in this analysis (Table 16) of inpatient readmission correlates, but were found to be significantly associated with ED admission hazard in Cox modeling previously discussed. This difference in significant activities among ED versus inpatient outcomes points to the possible differences in admission hazard or risk between the ED and inpatient settings in the study population. This is addressed further in the discussion chapter.

Structure and Process Variables Combined for Estimation of Inpatient of Readmission Risk

Research Questions 3 and 9

In an effort to test the combined association of patient demographic,

clinical and case management activity independent variables on the inpatient readmission outcome variable, six multivariate logistic models were specified and tested. This combination of variables was selected to reflect the interplay of patients and interventions and to assess this combination of variables in a risk estimation model. Table 17 displays the elements of Model 1 that include 24 variables containing Age, Race, primary Chronic Disease, and case management activity category (minutes) variables. Each of the four subcategories within the Identifying Need(s), Arranging, Explaining, and Monitoring case management activity categories were collapsed to make four categories. This was done for the purpose of simplifying the regression models and was based on the assumption that subcategories activities are similar to each other and can be aggregated for analysis. Model 1 output in Table 17 indicates that CHF is the only variable of 23 variables in the model to be significantly associated with readmission (OR 3.10, p=.008) at a p of < .05. Two case management variables in Model 1 are significant at a p of .06: Assessment (OR 1.06) and Identify Needs (OR .93).

Table 17

Multivariate Regression Model with Patient Age, Race, Primary Chronic Disease and Case Management Activity Category Independent Variables, Inpatient Readmission Outcome Variable

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 1				
Age Group <72	45	57	1.0	reference

72-77	41	61	1.03	.92

Table 16 continued

78-82	10	37	1.18	.59
83+	34	54	1.17	.63
Race				
White	147	209	1.00	reference
African American	6	7	0.78	.68
Other	10	7	1.60	.51
Disease				
Atrial Fib	24	24	0.83	.61
CAD	45	59	1.0	reference
CHF	12	40	3.10	.01
Diabetes	16	30	1.58	.23
Hyperlipidemia	11	9	0.65	.44
Hypertension	24	17	0.58	.15
Lung	25	48	1.61	.15
Renal	2	6	2.5	.29
Case Management Activity				
Assessment			1.06	.06
Identify Needs			0.93	.06
Explain: Diseases/Labs/Tests/Meds/Other			0.99	.43
Monitor: Routine/Abnormal/Services/Other			0.99	.81
Emotional Support			0.95	.42
Patient-Specific Travel			0.99	.38

Model 2 was specified with all variables of Model 1 with the exception of the (weakest p value) Age Group variables. The Model output is displayed in Table 18. Again, CHF was the only significant variable of 19 independent variables (Odds Ratio 3.2, p=.007) at the $p < .05$ level. The Assessment and Identify Needs variables maintained significance at a p of 06 with Odds Ratios of 1.07 and 0.93 respectively.

Table 18

Multivariate Regression Model with Patient Race, Primary Chronic Disease and Case Management Activity Category

Independent Variables, Inpatient Readmission Outcome Variable

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 2				
Race				
White	147	209	1.00	reference
African American	6	7	0.75	.64
Other	10	7	1.64	.49
Disease				
Atrial Fib	24	24	0.85	.64
CAD	45	59	1.0	reference
CHF	12	40	3.2	.01
Diabetes	16	30	1.57	.24
Hyperlipidemia	11	9	0.64	.42
Hypertension	24	17	0.58	.16
Lung	25	48	1.59	.16
Renal	2	6	2.5	.28
Case Management Activity				
Assessment			1.07	.06
Identify Needs			0.93	.06
Explain: Diseases/Labs/Tests/Meds/Other			0.99	.45
Monitor: Routine/Abnormal/Services/Other			0.99	.81
Emotional Support			0.95	.43
Patient-Specific Travel			0.99	.36

Model 3 removed Age and the weakest variable, Monitor (p=.81) from Model 2, resulting once again in statistical significance for CHF (OR 3.1, p=.007) and the Assessment case management activity (OR 1.106, p=.039). The Identify Needs case management activity Odds Ratio of .93 (p=.06) remained unchanged in this model. Model 4 removed the three Race variables (p >.48 and <.63) from Model 3, resulting again in statistical significance for CHF (Odds Ratio 2.7, p=.01) and the Assessment case

management activity (Odds Ratio 1.06, p=.04). The Identify Needs case management activity Odds Ratio of .93 remained unchanged with a slightly lower p of .05.

Model 5 removed the second weakest case management activity category, Arrange Services (p=.62), resulting in statistical significance for CHF (Odds Ratio 2.7; p=.0, no change from model 4) and the Assessment case management activity category (Odds Ratio 1.06, p=.03). The Identify Needs case management activity Odds Ratio of .93 remained unchanged with a slightly increased p of .06. The final Model 6 is displayed below in Table 19, with CHF and the Assessment case management activity associated with increased log odds of readmission.

Table 19

Final (Best Fit) Multivariate Regression Model with Primary Chronic Disease and Selected Case Management Activity Category Independent Variables, Inpatient Readmission Outcome Variable

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Model 3				
Disease				
Atrial Fib	24	24	0.81	.55
CAD	45	59	1.0	reference
CHF	12	40	2.70	.01
Diabetes	16	30	1.54	.25
Hyperlipidemia	11	9	0.75	.57
Hypertension	24	17	0.55	.11
Lung	25	48	1.50	.21
Renal	2	6	2.50	.29

Table 19 continued

Independent variable	1 Admission Group	2+ Admission Group	OR	p
Case Management Activity				
Assessment			1.06	.03
Identify Needs			0.93	.06
Explain: Diseases/Labs/Tests/Meds/Other			0.99	.44
Emotional Support			0.97	.44
Patient-Specific Travel			0.99	.31

Comparison of Case Management Time (mean Minutes) by Post -Admission Interval

Research Question 10

In light of the significant association between the several case management activity categories and readmission risk in the multivariate model (Table 19), a descriptive and comparative (Mann-Whitney test) analysis was completed of RN case management time (mean minutes) allocated to patients in the 1 inpatient admission versus 2+ inpatient admission subgroups within the 20 case management categories. Four post-admission time intervals representing number of days from the index admission within four time intervals were defined and employed to compare differences in case management time allocated to patients in the 1 versus 2+ admission groups after one index admission. These intervals were 0-30 days, 0-60 days, 0-90 days and 0-180 days. Case management time that is documented and then analyzed in the second, third and fourth intervals is cumulative. A maximum post -admission interval of 180 days was

selected to match the time period in which treatment effects for post acute admission transitional care coordination in chronic disease have been documented (Naylor, 2004).

Case management times for patients in the one admission group category were greater than patients in the 2+ admission category in 16 of the 20 group comparisons completed. Findings for the two case management categories that were significant in the final multivariate readmission risk model, Assess and Identify Needs, are displayed in Table 20. Each of the four intervals in Assess and Identify Needs: Medicare was statistically significant, as were the 0-90 and 0-180 day intervals in the Identify Needs: Other Non-Medicare. All significant case management times (minutes) were greater for patients with only one admission, with the exception of the Assess category in the 0- 30 day interval. The greater amount of case management time in the 2+ admission group in the 0-30 day Assess category may in part explain the significance of the category in the multivariate model in the prediction of readmission risk (see Table 19). It is evident from this analysis that patients who did not experience a readmission received more case management intervention time, with few exceptions, than patients who experience readmission.

Table 20

Mean Case Management Time (Minutes) by Category Post Index Admission for Inpatient Admission vs. 2+Inpatient Admission Group

Case management category	Interval (Days)	Mean minutes	Standard deviation	p
<u>Assess</u>				
Admission Group				

Table 20 continued

Case management category	Interval (Days)	Mean minutes	Standard deviation	p
	0-30			
1 Admission		2.31	7.78	
2+ Admission		2.70	18.67	.03
	0-60			
1 Admission		4.27	1.03	.04
2+ Admission		4.06	.36	
	0-90			
1 Admission		7.29	.73	.004
2+ Admission		5.10	.51	
	0-180			
1 Admission		17.52	34.28	.0001
2+ Admission		10.05	30.26	
Identify Needs: Other Non-Medicare				
Admission Group				
	0-30			
1 Admission		0.44	1.70	.12
2+ Admission		0.82	5.59	
	0-60			
1 Admission		1.19	0.65	.078
2+ Admission		0.11	0.75	
	0-90			
1 Admission		1.56	4.08	.04
2+ Admission		0.80	2.72	
	0-180			

Table 20 continued

Case management category	Interval (Days)	Mean minutes	Standard deviation	p
1 Admission		4.80	9.47	<.0001
2+ Admission		2.08	6.70	
Identify Needs: Medicare				
	0-30			
1 Admission		0.64	2.36	.05
2+ Admission		0.49	3.81	
Identify Needs: Medicare				
	0-60			
1 Admission		1.12	3.15	.03
2+ Admission		0.65	2.95	
	0-90			
1 Admission		1.81	4.47	.02
2+ Admission		0.84	2.81	
	0-180			
1 Admission		4.46	7.85	<.0001
2+ Admission		2.09	7.59	

Of the additional 56 comparisons completed (0-30, 0-60, 0-90, and 0-180 days after an index admission) in the remaining 15 case management categories, a total of 17 one admission versus 2+ admissions mean case management (median) time comparisons were statistically significant (p <.05, Mann-Whitney). These findings are narratively summarized here. In the 0-30 day and 0 to 60 day post admission intervals, case

management time for patients with 2+ admissions exceeded that of one admission group patients in 5 of the 17 statistically significant comparisons. These significant activity categories were: Monitor: Routine, Documentation (x2), Arrange Services: Other Non-Medicare, and Explain: Disease/Self -Care. Time for readmitted patients in the latter two categories may be driven early in the post-admission interval by physical care and symptom management needs.

In the 0 to 60 day post admission interval, patients in the one admission group received more ($p < .05$) case management time in the Explain: Medications, Monitor: Routine, Monitor: Other, and Emotional Support categories. Case management times in the Arrange: Services: Other Non-Medicare, Explain: Disease/Self-Care, Explain: Labs/Tests, Explain: Medications, Monitor: Routine, Emotional Support, and Documentation categories were greater and robustly significant ($p < .0001$ to .001) in the 0-90 and 0-180 post index admission interval for patients in the 1 admission group compared to patients in the 2+ admission group. These findings indicate that patients who did not experience an inpatient readmission during the study period received more case management time overall and a greater range of targeted case management intervention.

Comparisons of Case Management Times Pre and Post Index Admission

To determine whether differences in both pre and post index admission (includes both ED and inpatient) case management time existed for the 1 versus 2+ admission group, analysis was completed with the use of standardized case management times for each of the 20 case management activity categories. This analysis was conducted to determine whether there were significant differences in case management patterns pre

and post admission. Separate before and after time (mean minute) rates based on average case management time/per 30 days for each of 20 case management categories were calculated for the 1 versus 2+ inpatient admission groups. These medians were then compared/analyzed (Mann-Whitney test). Median case management times for each admission group and for each of the 20 categories are noted in Table 21.

Consistent with findings of the variations in case management time (0-180 days) after index admission (see Table 20), case management time before and after inpatient admissions for patients with one admission were in 34 of 40 instances greater than for patients with 2+ more admissions. Nearly all these differences were significant at a p <.05. The Assess category and two of four Identify Needs categories (Identify Needs: Medicare and Identify Needs: Other Non-Medicare) were significantly (p of <=.001) different and greater in mean minutes for the one admission group both before and after the index admission. Mean time (minutes) for Identify Needs: Personal Care and Identify Needs: Transportation was not significantly different for the one admission group before the index admission, though it was significantly different, and slightly greater for the one admission group after the index admission.

Table 21

Pre vs. Post Index Admission Case Management Mean Time (minutes) per 30 days by Admissions Group and Case Management Category

Case management activity category	Admission	Mean	SD	p
Assess				
Pre-Admission	1 Admission	2.99	5.93	<.0001

Table 21 continued

Case management activity category	Admission	Mean	SD	p
	2+ Admission	1.85	5.04	
Post Admission	1 Admission	7.07	5.10	<.0001
	2+ Admission	2.42	7.22	
Identify Needs: Personal Care				
Pre-Admission	1 Admission	0.08	0.31	<.29
	2+ Admission	0.07	0.30	
Identify Needs: Personal Care				
Post Admission	1 Admission	0.09	0.14	<.0001
	2+ Admission	0.08	0.31	
Identify Needs: Transportation				
Pre-Admission	1 Admission	0.06	0.22	<.42
	2+ Admission	0.06	0.28	
Post Admission	1 Admission	0.07	0.12	<.0001
	2+ Admission	0.06	0.23	
Identify Needs: Other Non-Medicare				
Pre-Admission	1 Admission	0.57	1.35	<.0001
	2+ Admission	0.29	0.99	
Post Admission	1 Admission	1.88	0.87	<.001
	2+ Admission	0.44	1.52	

Table 21 continued

Case management activity category	Admission Group	Mean	SD	p
Identify Needs: Medicare				
Pre-Admission	1 Admission	0.69	1.61	.0013
	2+ Admission	0.45	1.28	
Post Admission	1 Admission	0.96	0.70	<.0001
	2+ Admission	0.42	1.31	
Arrange: Personal Care				
Pre Admission	1 Admission	0.04	0.15	.056
	2+ Admission	0.09	0.63	
Post Admission	1 Admission	0.04	0.11	<.0001
	2+ Admission	0.03	0.15	
Arrange: Transportation				
Pre Admission	1 Admission	0.04	0.22	.19
	2+ Admission	0.04	0.23	
Post Admission	1 Admission	0.04	0.10	<.0001
	2+ Admission	0.04	0.19	
Arrange: Other Non Medicare				
Pre Admission	1 Admission	1.03	2.18	<.0003
	2+ Admission	0.56	1.51	

Table 21 continued

Case management activity category	Admission Group	Mean	SD	p
Post Admission	1 Admission	1.42	1.05	<.0001
	2+ Admission	0.85	2.08	
Arrange: Medicare				
Pre Admission	1 Admission	0.62	1.26	<.011
	2+ Admission	0.60	1.63	
Post Admission	1 Admission	0.80	0.56	<.0001
	2+ Admission	0.62	2.09	
Explain Disease/Self-Care				
Pre Admission	1 Admission	1.57	3.04	.0003
	2+ Admission	0.96	2.56	
Post Admission	1 Admission	2.76	1.98	<.0001
	2+ Admission	1.31	3.89	
Explain: Labs/Tests				
Pre Admission	1 Admission	0.86	2.34	.0006
	2+ Admission	0.55	1.54	
Post Admission	1 Admission	1.47	1.19	<.0001
	2+ Admission	0.70	2.21	
Explain Medications/Treat.				
Pre Admission	1 Admission	1.77	10.01	.0004
	2+ Admission	0.65	0.83	
Post Admission	1 Admission	1.76	1.34	<.0001

Table 21 continued

Case management activity category	Admission Group	Mean	SD	p
	2+ Admission	1.02	3.19	
Explain: Other				
Pre Admission	1 Admission	0.34	0.86	.03
Pre Admission	2+ Admission	0.26	0.75	
Post Admission	1 Admission	0.34	0.35	<.0001
Post Admission	2+ Admission	0.41	1.49	
Monitor Routine				
Pre Admission	1 Admission	2.59	5.01	.0001
Pre Admission	2+ Admission	1.27	3.54	
Post Admission	1 Admission	2.66	1.93	<.0001
Post Admission	2+ Admission	1.83	5.00	
Monitor: Services				
Pre Admission	1 Admission	0.28	0.86	.022
Pre Admission	2+ Admission	0.19	0.67	
Post Admission	1 Admission	0.48	0.44	<.0001
Post Admission	2+ Admission	0.22	0.75	
Monitor: Abnormal Results				
Pre Admission	1 Admission	0.22	0.68	.082
Pre Admission	2+ Admission	0.15	0.62	
Post Admission	1 Admission	0.46	0.45	<.0001

Table 21 continued

Case management activity category	Admission Group	Mean	SD	p
Post Admission	2+ Admission	0.26	1.10	
Monitor: Other				
Pre Admission	1+ Admission	0.27	0.85	.026
Post Admission	2+ Admission	0.19	0.72	
Emotional Support				
Pre Admission	1 Admission	0.73	2.57	.0035
	2+ Admission	0.31	0.93	
Post Admission	1 Admission	1.22	0.99	<.0001
	2+ Admission	0.41	0.27	
Patient Specific Travel				
Pre Admission	1 Admission	1.00	2.66	.0009
	2+ Admission	0.50	2.16	
Post Admission	1 Admission	1.45	1.49	<.0001
	2+ Admission	0.94	3.89	
Document				
Pre Admission	1 Admission	11.46	19.82	.0002
	2+ Admission	7.35	18.22	
Post Admission	1 Admission	14.65	9.25	<.0001
	2+ Admission	9.89	21.27	

Although most of these categories of case management were not, when similar activity subcategories were collapsed, found to be significant in the final multivariate model for predicting readmission, there were systematic differences found in all 20 categories in case management time allocated to patients who experienced no inpatient readmissions compared to those with 2+ admissions. Identifying the need for and arranging personal care services and transportation services, and monitoring abnormal results were the only case management activities that were not significant in the period before index admissions for patients with only one admission (thus no readmissions). The remaining 15 case management categories were significantly associated with the one admission patient group, meaning that patients in this group received more case management time both before and after the index admission in each of these 15 categories. These 15 activity categories represented assessing, identifying and arranging for health needs, disease and self-care education and monitoring. Readmitted patients received less case management time in virtually every case management activity category before and after admission.

CHF-Case Manager Data Drill-Down

Research Questions 5, 6, 7, and 10

Older adults with CHF have the highest hospital readmission rate of any adult patient (AHA, 2005). Care coordination interventions delivered as part of transitional care for CHF patients who are experiencing inpatient admission can reduce readmissions during the six months following discharge (Naylor et al, 2004). In this study, CHF patients were consistently documented in univariate and multivariate analyses as the chronic disease diagnosis population with the highest inpatient readmission rate of all

chronic disease subgroups. For this reason, additional analysis of the character and timing of case manager care coordination for CHF patients was conducted. The purpose of this analysis was to describe RN case management interventions for CHF patients and to document the timing, type and time characteristics of RN case management activities for this MCCD subgroup. Analyses included descriptive analysis of case management time provided to CHF patients, and analysis of case management contact timing preceding admission.

Case Manager Time Allocation to Patients with Primary CHF Diagnosis

The amount of time spent by each case manager providing care to CHF patients was analyzed to determine how CHF case management time varied between case managers over the 2002-2005 period (Figure 5). The purpose of

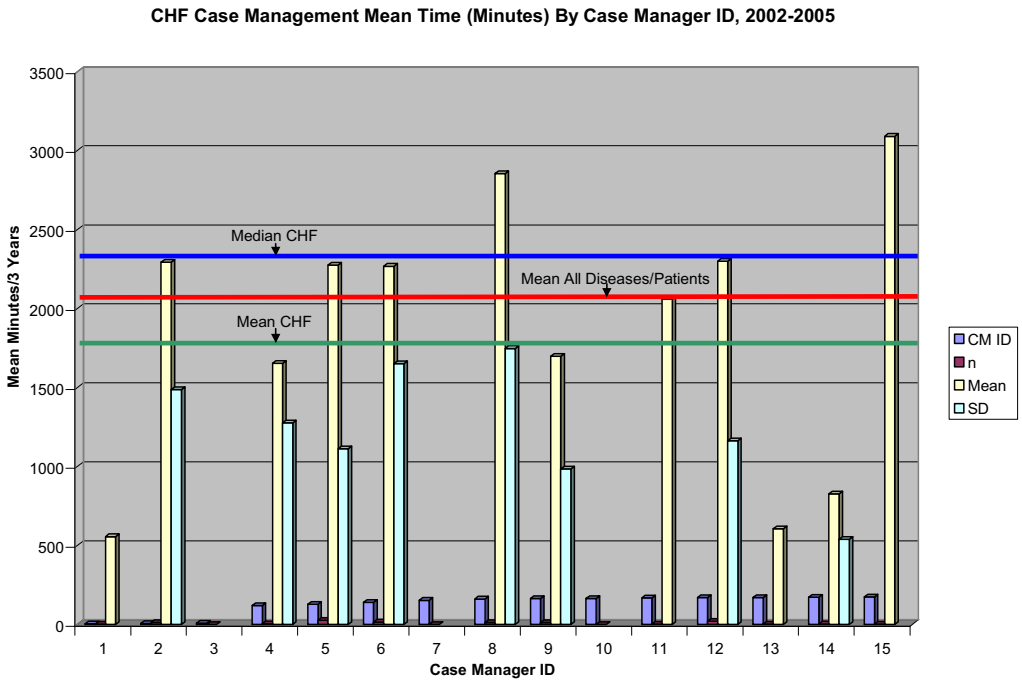


Figure 5. CHF case management mean time (minutes) by Case Manager ID, 2000-2005

this analysis was to document the nature, if any, of variation in case management time for the higher-risk CHF patients versus patients in other primary chronic disease categories. The minutes graphically displayed in Figure 5 represent the mean total minutes/patient recorded by all Case Managers for treatment of patients in the CHF disease category over four years. The bars in the graph represent the mean of minutes per patient by individual case managers for all case management time documented for CHF patients for four years. The median and mean lines crossing the bars reflect the mean of minutes/patient for all patients in the study (red line), mean of minutes/patient for CHF patients (green line) and median of minutes/patient for CHF patients (blue line). Mean CHF minutes are lower than the mean for all patients/all diseases in part due to low minutes of three case managers, and also because CHF patients comprised a modest percentage (19%) overall of all MCCD patients. The graph reveals that 7 of 12 Case Managers' mean minutes for CHF patients exceeded the mean minutes calculated for all patients/all diseases. Table 22 is the source data for the graph; the graph represents, as described above, the mean minutes/patient for CHF patients by individual Case Manager.

Table 22

CHF Case Management Mean Time (Minutes) by Case Manager ID, 2002-2005

RN ID	n	Mean minutes/ CHF patient	SD	Lower 95% CI	Upper 95% CI	Median Total minutes
RN 3	1	555	-	-	-	-
RN 4	11	2294	1486	1296	3293	1975
RN 118	3	1653	1276	1516	4823	2170

Table 22 continued

RN ID	n	Mean minutes/ CHF patient	SD	Lower 95% CI	Upper 95% CI	Median Total minutes
RN 127	24	2274	1112	1805	2744	2232
RN 139	14	2267	1650	1314	3220	2015
RN 160	11	2854	1746	1680	4027	2475
RN 163	11	1697	984	1036	2358	2045
RN 167	1	2060	-	2060	-	-
RN 168	19	2300	1162	1741	2861	2385
RN 170	1	605	-	-	-	-
RN 171	2	825	537	-	-	-
RN 174	1	3090	-	3090	-	-

The median total minutes/CHF patient for case managers does show some variation, ranging from 1975 to 2475 minutes/CHF patient. Case managers with > 2 patients displayed a range of mean case management time for CHF patients of 1653 to 2300 minutes. There were no statistically significant differences in mean case management time for CHF patients compared to mean case management time for patients in all disease categories (ANOVA, p=.50). This indicates that there were no systematic differences in the average case management time allocated to CHF patients compared with patients with other primary chronic diseases. Minutes of case management time

were not significantly affected by the variation in length of employment of RN case managers, with only two case managers terminating participation in the study in the first or second quarter of the last year of the study period (2005); their case loads accounted for less than 2 % of Carle MCCD patients. Case managers were otherwise enrolling patients/managing care for the entire study period, so that "enrollment exposure" for case managers would not explain variation of median total minutes over the study period.

Analysis of Case Management Timing for CHF Patients

Case management times were further analyzed to determine if the case managers' time allocated to CHF patients varied in four distinct time intervals between the last documented case manager- patient contact and a subsequent admission (Table 23). The time interval analysis documents case management timing and mean rate (in minutes) in relationship to all admissions whether initial or readmission. This analysis was performed to look at differences in case management time allocated prior to any admission and the number of days elapsed between last case manager contact and subsequent admission. The analysis was intended to document a case management dose-timing association, if any, with hospital admission events. These intervals represent all documented intervals of time (a range of 2 to 402 days) between last case manager contact and subsequent admission. This time range was then divided into quartiles based on equal numbers of contacts. These quartiles are: 2 to 22 days, 24 to 64 days, 65-166 days, and 167 to 402 days and the minutes are not cumulative. There were significant differences between time allocated to case management categories between the four separate day intervals (Two-Factor ANOVA p =.01) and between each case management category over time (Two

Factor ANOVA p <.0001), with RN time predominantly focused on Assessment, Identify Needs, Explain: Disease/Self-Care, and Explain: Medications activity categories.

Table 23

Case Manager Mean Time by Interval from Last Case Manager Contact with CHF Patients to Time of Subsequent Admission

Case management Activity category	Days between last contact and subsequent admission and mean case management time/interval			
	2-22 Days	24-64 Days	65-166 Days	167-402 Days
Assess	20.0	89.0	137.5	103.33
Identify Needs: Personal Care	0	1.0	1.25	1.67
Identify Needs: Transportation	0	1.0	1.0	3.33
Identify Needs: Other Non Med.	10.0	13.1	8.54	11.55
Identify Needs: Medicare	8.33	18.0	15.0	8.33
Arrange Services: Personal Care	0	1.0	1.0	1.67
Arrange Services: Transportation	0	1	0	3.33
Arrange Services: Other	8.33	20	25.0	35.10
Arrange Services: Medicare	0	21	16.25	10.0
Explain: Disease/ Self-Care	16.67	53.0	47.5	31.67

Table 23 continued

Case management Activity category	Days between last contact and subsequent admission and mean case management time/interval			
	2-22 Days	24-64 Days	65-166 Days	167-402 Days
Explain: Labs/ Tests	1.67	28.0	4.0	3.0
Explain: Meds/ Treatments	6.67	37.0	40.0	21.67
Explain: Other	1.67	10.0	15.0	10.0
Monitor: Routine	20.0	55.0	92.5	78.33
Monitor: Services	1.67	10.0	5.0	5.0
Monitor: Abnorm. Labs/Tests	10.0	3.0	7.5	11.67
Monitor: Other	0	4.0	8.75	1.67
Emotional Support	0	17.0	11.25	10.0
Patient-Specific Travel	13.33	57.0	66.25	41.67
Document	198.33	283.0	323.75	476.43

Graphic comparison of differences in 20 case management categories was completed to aid in analyzing relative differences in RNs' case management time allocations between intervals. The tabled and graphed data revealed the time/activity distribution in Figure 6.

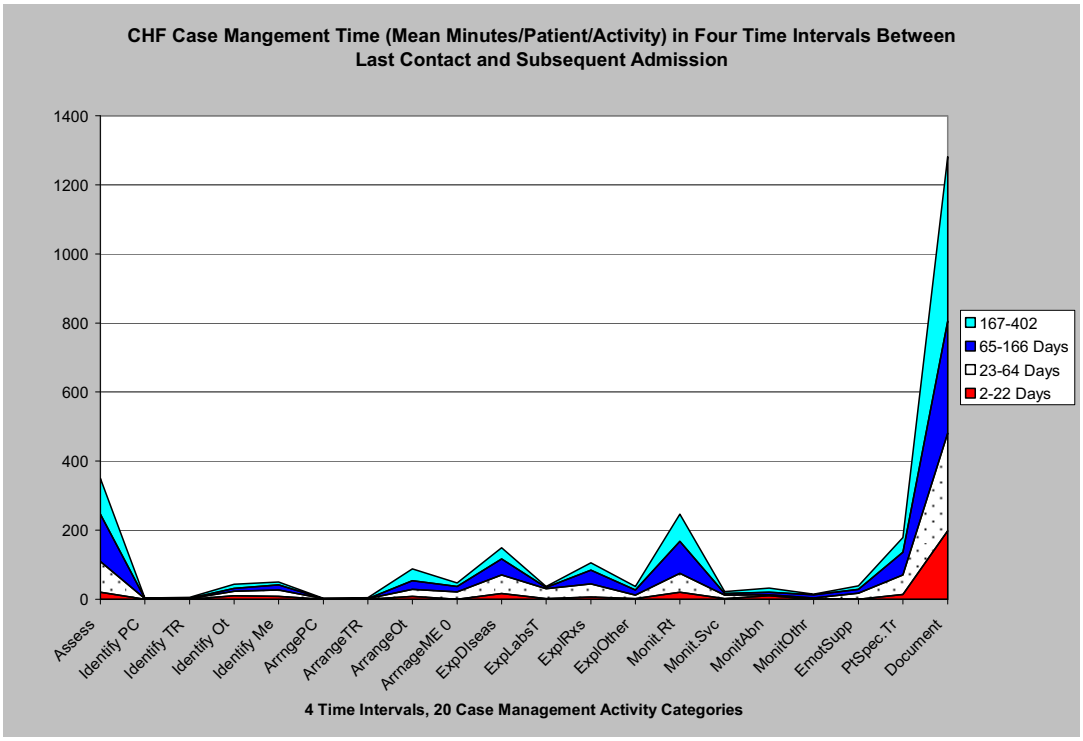


Figure 6. CHF case management time (mean minutes/patient/activity) in four time intervals between last contact and subsequent admission

Analysis of the graphed data revealed the following:

- Less time (in minutes) was documented in Explain: Medications/Treatment to patients with contact in the 2-24 day interval preceding inpatient admission(s) than in the other three intervals. Explain: Disease/Self-Care and Monitor time appear roughly equivalent to each other in the 2-24 day category—this is different in the latter three categories, where Monitoring time was relatively greater than time spent in Explain: Disease/Self-Care.

- Explain: Disease/Self-Care accounts for more time in the 23-64 day intervals, than later intervals or in the 2-22 day interval. Explain: Medications/Treatment minutes

are lower than Explain: Disease/Self-Care minutes in all time intervals except the 65-166 day interval. These differences may reflect changes in patients' health status and symptoms that in turn affect the nature of acute case management interventions. Time allocated to Explain: Medications/Treatments and Explain: Disease/Self-Care was greatest in the 23 to 64 and 65 to 166 day intervals respectively, though the last interval of 167 to 402 days was 236+ days longer than these other two intervals. RN case management intervention activities in the Explain category declined over time, as did Identify Needs: Medicare and Arrange Services: Medicare.

- More time was documented in the 24-64 day interval in the Explain: Disease/Self-Care activity and Explain: Labs/Tests than in any other category in the 24-64 day interval. This activity focus may be a function of changes in health status and related clinical evaluation tasks.

- More time was documented in the 65-166 days interval in Explain: Medications/Treatment and Monitor: Abnormal Labs/Tests and much less time spent in Explain: Diseases/Self-Care. The relatively greater amount of time spent in explaining medications and treatments in this interval may be affected by changes in patient medications or responses to medication over time.

- Most time was spent in the Arrange Services: Other (non clinical services such as meals, personal care services) activity in the 167-402 day interval than in the other three time intervals.

- More time is spent in the latter two day intervals in Monitor: Routine than in Explain: Diseases/Self Care.

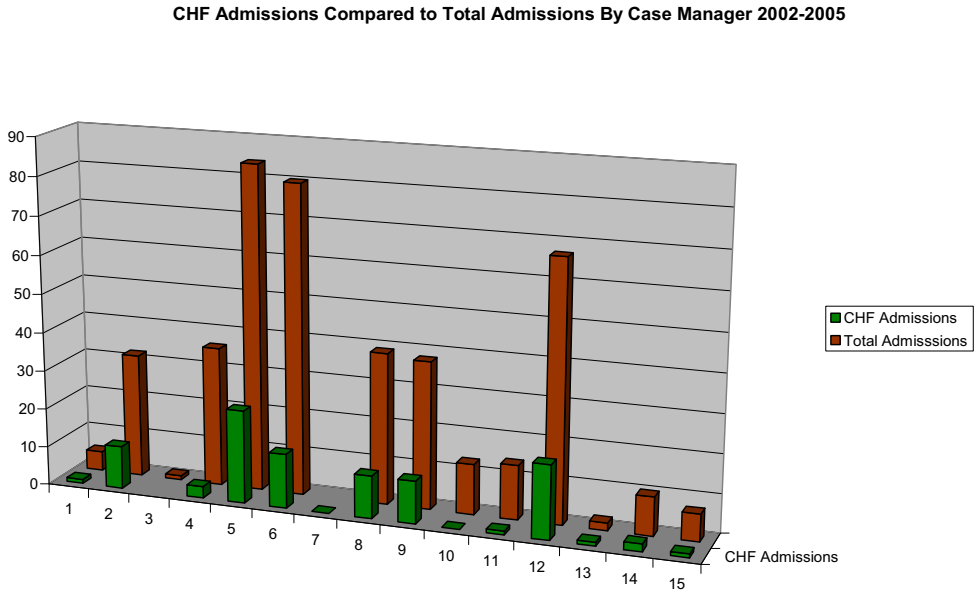
- There was no time documented in the Emotional Support activity category in the 2-22 day category, and the most emotional support time was provided to patients in the 24-64 day time interval.

Monitor: Routine time appears substantial in the 65-166 day intervals, and dominates all direct care coordination activities in this interval other than Assessment. Within the Carle MCCD research design, Routine Monitoring typically occurred at three month intervals or more often in the patient circumstances/need dictates, thus this activity would be expected to be associated with time than many other categories. Overall, the Explain: Medications/Treatments activity (in minutes) is lower in shorter contact to admission intervals and greater in the longer contact to admission intervals. This observation requires further elaboration in future studies.

Inpatient Case Mix Comparisons between Case Managers

A review of case manager patient case-mix was completed to determine if case managers differed on the number of inpatient admitted CHF patients each cared for as a subset of all MCCD chronic disease patients/admissions, or if CHF admissions comprised the majority of admissions for particular case managers. Figure 7 displays the number of CHF admissions/case manager compared to total admissions per case manager. The

analysis reveals that CHF admissions of each case managers' total admissions comprise a similar proportion of each case manager's associated admissions.



Legend

Column Number	CM ID	Column Number	CM ID
1	3	8	160*
2	4	9	163*
3	7	10	164
4	118*	11	167
5	127	12	168*
6	139*	13	170
7	152	14	171
		15	173

:* = Case Managers with significant reduced readmission log odds in univariate analysis

Figure 7. Case Manager CHF patient admissions compared with total admissions by Case Manager, 2002-2005

Total admissions/all primary chronic diseases/case manager ranged from 1 to 84 over the four year period. Some of the case managers with very low admissions were not participants in the MCCD for the entire four year period. Inpatient admissions of CHF patients among case managers appear similarly distributed across case managers and delivery sites. Patients with a primary or secondary CHF diagnosis accounted for approximately 10% of each case manager's case load, with a range of 0 to 20 %, and a median of 9.8%. No one case manager produced a disproportionate share of CHF admissions out of total admissions. Mean percent of CHF as a percent of total admissions for case managers was 24.33%, with a range of 0% to 30% (total discharges of 1 or 2 were eliminated from the analysis to eliminate low volume outliers) with a standard deviation of 16.86%. CHF constitutes 24% of admissions in this study, and approximately 19% of all known chronic disease diagnoses in the MCCD population. Since CHF is the most common cause of acute inpatient readmission in chronically ill older adults, this slight over-representation among MCCD admissions is not unexpected.

Analysis of Individual Case Manager Time Means/Variations for CHF Patients

Descriptive analyses were completed for case managers' mean, standard deviations (SD), confidence intervals, and median times for all case management time allocated to patients with a primary CHF diagnosis for the 2002-2005 period (Figure 8). Each successive set of grouped bars, 1 through 5, represents a separate descriptive analysis of case management time for all CHF patients-linked to individual RNs over the 2002-2005 period. The clustered bars include (in order) the mean, standard deviations (SD), confidence intervals, and median times of each case manager's CHF patient subgroup. The time represented is for all CHF patients, regardless of whether they were

admitted or not. The purpose of the analysis was to compare variation in CHF patient case management mean times between case managers. The source data for the grouped bars is noted in the table below the graphic, and data are stratified to reflect individual case managers. The individual bars reflect mean data for individual RN case managers; RNs with only 1 or 2 CHF patients admitted during the 2002-2005 period were excluded from the analysis to eliminate small volume outliers.

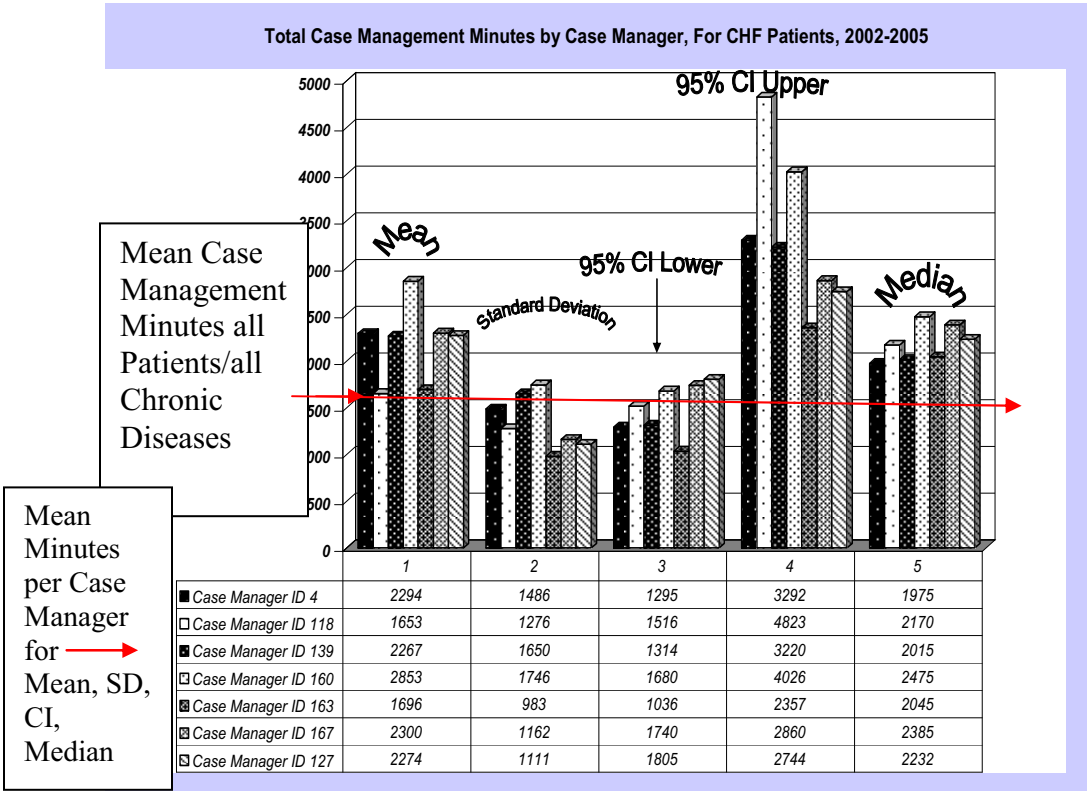


Figure 8. Mean of total case management minutes by Case Manager for all CHF patients, 2002-2005

The comparative bar graphs reveal that the most variation in case management activity time is seen in the upper 95% confidence level. The red horizontal line crossing

the bars in Figure 8 represents the mean total minutes of case management for all patients/all primary chronic diseases over the study period. Only one case manager's time (Case Manager ID 160) appreciably exceeds the grand mean of approximately 2100 minutes over four years. In previously described multivariate logistic regression analyses, Case Manager 160 had a significant ($p<.05$) and reduced log odds (0.40) of CHF patient readmission. Reduced readmission risk was documented for this same case manager in univariate analysis of all-cause readmission risk (OR 0.14, $p=.0095$).

In previously described multiple logistic regression analysis, Case Manager 118 had a significant ($p< .05$) and reduced log odds (0.45) of CHF patient readmission, and the lowest mean minutes of CHF case management activity, yet the greatest upper CI variability (Figure 8) of other case managers (with > 2 CHF patient admissions). Case Manager 118 was also associated within reduced all-cause readmission risk in univariate analysis (OR 0.13. $p=.0006$). Case Managers 139 (OR 0.22, $p=.0042$) and 168 (OR 0.24, $p=.0095$) were each associated with decreased log odds for all-cause readmission risk in univariate analysis, but this same association did not extend to CHF readmission risk in separate multivariate readmission risk models involving individual RNs and diseases. CHF patient acuity may explain why these two case managers were less successful in controlling CHF patient readmission than readmissions of patients with other primary chronic diseases.

In Figure 8, little notable variation from the grand mean was observed for Case Manager 127, who had the highest volume of CHF patient admissions for 2005-2005, had 1 of the 2 two highest patient readmission volumes for all diagnoses, neither high nor low mean CHF case management time, and who was found to have no statistically significant

reduced CHF patient admission log odds/risk in the univariate and multiple logistic regression analyses ($p < 05$). Case Manager 127 was also found to have an RN ID *Diabetes interaction in two multiple logistic regression (OR 10.2, p=.054,) analyses and an RN ID*CHF (OR 8.4, p=.075) interaction as well, each in models controlling for the effects of CHF on readmission risk.

Case Manager 4 was identified in previously described multiple logistic regression analyses to have a significant (p= .016) association with increased readmission risk (OR 3.4) for CHF patients. In Figure 8, Case Manager 4 is shown to have the third highest mean minutes and the lowest (of seven case managers) median minutes of per patient case management activity. Case Manager 4's upper 95% confidence interval value is greater than four of six case managers in the analysis. This suggests substantial variability in time allocated to CHF patients, though relatively low overall time allocated to patients. Case Manager 4 had a volume of patient admissions that was moderate (33) compared other case managers for the same time period.

This analysis of CHF patient case management characteristics suggests that average case management time/CHF patient during the study period varied slightly, though there was no specific rate that was documented to be associated with individual case managers and CHF readmission risk. This analysis did document that individual RNs spend, on average, slightly more time on CHF case management, but not significantly more time than patients with other primary chronic disease diagnoses (ANOVA, p=.59). Several individual RNs were associated with reduced log odds of readmission as noted.

Post Index (CHF) Inpatient Admission Analysis

A separate analysis of post-admission time intervals (table not displayed here) was completed for the purpose of analyzing the timing of case manager contacts in relationship to inpatient admissions. Comparisons were completed of differences in mean amounts of case management time for CHF patients with only 1 inpatient admission versus those with 2+ admissions, similar to the analysis conducted for all patients (Table 20) except focused on CHF patients. Case manager contacts occurring within 30, 60, 90 and 180 days from an inpatient admission were compared for the purpose of identifying the association between the timing and amount of case management contacts in the two admission groups. In this analysis, the Explain: Disease/Self-Care activity was found to be more commonly provided (Mann-Whitney test, $p<.05$) and provided sooner after admission for patients experiencing only one admission. More minutes in the Explain: Medications/Treatments, Explain: Lab/Tests, Explain: Other and Assessment activity categories were associated with patients having only 1 admission compared those with 2+ admissions (Mann Whitney test, $p<.05$). Minutes were modestly higher—1 to 5 minutes—in these 1 admission groups compared to the 2+ admission group. Minutes were also 0.75 to 1.5 minutes higher and significant (Mann-Whitney $p= .02$-$.08$) in the 61-90, 91-180 day intervals for the Identify Needs: Non-Medicare and the 31-60 and 91-180 intervals for Arrange Services: Non-Medicare categories, and in the 61-90 day interval for the Identify Needs: Medicare category. In These findings are consistent with Naylor and colleagues' work (2004) in transitional care coordination for patients with CHF, in which targeted case management time reduces readmission risk. These findings add further detail to the impact of specific case management activities on patient outcomes, adding Explain: Medications/Treatments and

Explain Disease/Self-Care to the significant activities of Identify Needs and Assessment, expanding the list of case management activities associated with lower readmission rates.

Patient Contact Table Analysis

Purpose and Sample

To better understand the nature of RN case manager interventions with patients experiencing admissions, an analysis of a sample of nurse case management narrative documentation was completed. The day-to-day free text records of case managers' activities and communications with patients, caregivers, and other providers were viewed as a rich information source for better understanding differences in case management time provided to patients experiencing ED and inpatient admission.

The number and timing of contacts of 25 patients experiencing ED or inpatient admissions were examined to determine the character and timing of CM interventions with patients, caregivers, hospital-based and community-based providers. The purpose of this descriptive/qualitative review was to identify the timing and focus of case manager contacts with patients experiencing admissions, and to assess the degree to which transitional care coordination was conducted by case managers. Transitional care coordination includes many aspects of care coordination, and was one focus of the Carle MCCD intervention design.

For this analysis, patients were selected randomly from the data table of patients admitted over the 2003-2005 period with Client ID numbers ranging from 3500 to 3900. Approximately 2,000 individual contact records for patients were examined for content, dated notations of contacts relative to ED or inpatient admissions, specific themes related to admissions, patient's health status, and communication with providers. Patients'

primary chronic disease diagnoses were compared to ED or inpatient admission diagnoses documented in the narrative contact records. The purpose of this comparison of diagnoses was to determine whether most/all admissions were related to baseline chronic diseases or related treatment. Patient diagnoses represented a mix of chronic diseases, with CHF, CAD and Lung diseases common among the sampled patients/case managers. Coded summaries of each of the records were reviewed, including documentation of intervals from time of inpatient or ED admission to time of case manager contact. The summaries are contained in Appendix B.

Findings

The review of case manager contact records revealed consistency in care coordination activity and communications before, during and following inpatient and ED episodes of care, both unscheduled and scheduled. This was evidenced by usually daily contact by case managers with either patients, caregivers or healthcare providers regarding patients' condition, health status, self-care abilities, treatment changes and patient and caregiver functional capacities. Guided by Carle MCCD policies requiring timely follow-up of admissions, RN Case Managers followed up via telephone on inpatient or ED admission after Carle email system notification or notification by patients/family of MCCD patient admission activity. Contact processes were most often documented within 1 to 2 calendar days of ED or inpatient admission notification. Many more attempts at communicating with hospital discharge planners were documented than were actual direct communications. MCCD RNs' care coordination appeared to be challenged by the contact barriers intrinsic to hospital-based service providers, not a surprising finding.

The common purpose of telephone communication with inpatient hospital staff was to inform them of patients' participation in the MCCD and of existing care coordination activities and arrangements. Hospital visits were made in specific cases by MCCD case managers to review patient records to assess treatment and condition, visit patients when possible, and communicate with healthcare providers. There was limited specific documentation in the reviewed records about how discharge planning was coordinated with inpatient discharge planning staff, though MCDD case managers consistently documented advising inpatient staff that patients were part of the Carle MCCD case management program. These communicating and coordinating activities would likely be documented in the Monitor activity categories or Arranging Services activity categories, consistent with Carle MCCD documentation policies and procedures; each category comprised no more than 2% of RN Case Managers' time. Alternatively, a portion of transitional care coordination time may have been documented in the Assessment category, which comprised 16-18% of total case management time provided over the span of the four year study period.

Many case manager contacts with providers and family caregivers occurred within 1 to 2 days of patient admission, consistent with Carle MCCD policies and previously mentioned transitional care best practices. Telephone and in-person contacts continued through discharge and after discharge for as long as increased monitoring activity appeared warranted by the patients' condition, symptoms, and functional status. Patient contact following discharge to home or SNF was consistently attempted and documented, though not always completed. Home visits supplemented telephone communications post discharge, though this was less common than telephone calls or

office visits co-occurring with PCP follow-up visits. RN communication with PCPs was frequent and disease management-focused, reflecting MCCD care coordination policies, and measured by nurse-documented, in-person, telephone or email contacts. Case Manager-PCP communications commonly addressed treatment and care planning information and transitional care needs. Patients' education regarding new medications, symptom management or follow-up clinical care was a common feature of documented post-discharge case management activities. This is consistent with Carle MCCD policies as well as the evidence base in transitional care previously described.

Themes in the examined narrative records reflect a myriad of issues and explain some of the reasons patients utilized ED services. Documented reasons included bleeding from side effects of anticoagulants commonly prescribed for patients with CHF and Atrial Fib, side effects of new or changed dose antihypertensives, an array of central nervous system effects from analgesics including non-steroidal anti-inflammatories and opiates, and injuries occurring secondary to presyncope (pre fainting), gait disturbances, balance disturbances, or physical deconditioning following acute illness or immobility. A few patients experienced allergic reactions to medications, and some suffered the debilitating effects of dehydration due to gastroenteritis, mostly viral or bacterial in origin. Others experienced acute exacerbations of COPD or CHF and needed immediate intervention. A number of inpatient admissions were related to short-stay orthopedic procedures, short-stay gastrointestinal and surgical oncology procedures, cardiovascular diagnostic and therapeutic procedures, musculoskeletal injuries from falls, and CHF and COPD symptom exacerbation.

Medication side effects and new medications were a common theme in case management narrative records outside of notes related to ED admissions. This is not surprising considering the number and type of new and existing medications older adults are routinely prescribed and receive after inpatient or ED admission. In this study, a sample of 17,000 patient medication records was reviewed in preliminary studies and descriptively analyzed. The top 10 medications MCCD patients were prescribed included a range of antihypertensives, lipid statins, ACE Inhibitors (for treatment of hypertension and CAD), antiarrythmics, diuretics, potassium chloride and anticoagulants (Appendix D). Singly or in combination, these medications can and do generate a plethora of side effects, and these were a common feature of post- admission or post PCP visit care coordination. As was demonstrated in both descriptive summaries of case management activity distributions, medication teaching was one of the most commonly documented categories of skilled nursing intervention in this study. Given the potential side effects of the many medications that chronically ill, older adults are prescribed, the Explain: Medications/Treatments function of RN case management is important in the coordination of chronic care and in related nursing interventions. This activity accounted for approximately 4% of case management time documented over the four year study period, adjusted for patient enrollment months.

This descriptive analysis of narrative records reveals a more comprehensive, time-intensive coordination process regarding transitional care that is not well illustrated in the 0 to 180 day post-discharge analyses completed and described earlier. There are limitations to focusing soley on quantitative analyses of case management mean minute distributions to explain readmission risk. The findings also suggest that patients

experiencing admissions received care coordination consistent with Carle MCCD policies, which in turn were consistent with the evidence base in transitional care. This finding also may explain the previously described quantitative analysis finding that nearly all RN Case Managers were found to be associated with decreased risk of inpatient readmission. Following evidence-based practice in transitional care may, as the MCCD RNs documented, in part explain the reduced risk of readmission documented in this study.

DISCUSSION

This study contributes to the limited data available on the nature of and resource applications of RN-delivered chronic care/case management in a longitudinal, RCT study. The distribution of RN case managers' care coordination time across all patients, and across subgroups of patients with specific chronic diseases, total numbers of diagnoses, specified demographic characteristics, and specified inpatient and ED admission categories was identified and then analyzed with descriptive, univariate and

multivariate statistical techniques. The documentation of RNs' chronic care case management activities, timing and time allocation in this study, and the identification of associations between the structural and process variables of chronic care and patient outcomes are important additions to the current literature in nurse case management in chronic disease.

This study aimed to describe features of protocol-guided care coordination by RNs of community-dwelling, chronically ill older adults. The study also aimed to determine the association of RN care coordination interventions with selected categories of health services utilization, namely ED and acute inpatient admissions and readmissions. Specifically, this study aimed to identify which aspects of RN case management, involving activity type, timing and time, were associated with significant reductions (or increases) in odds of all-cause ED use and inpatient admissions, as well as inpatient readmission in the MCCD population..

Inpatient and ED Admission Frequencies

MCCD patients had a lower than expected inpatient and ED admission rate. A total of 1, 777 admissions were generated by 768 MCCD patients for the 2002 to 2005 period (Table 3). Sixty nine percent (n=536) of MCCD patients experiencing inpatient admissions had two or fewer admissions during the four year period, and eighty percent (n=630) of those admitted had three or fewer admissions. Seven percent of patients had six or more admissions during the treatment period (Table 3). Fifty percent of treatment group patients (n=783) had no documented inpatient admissions during the four year study period. The significance of these lower than expected rates of admission is beyond

the scope of this study, but it is a component of RN case management effectiveness warranting further study.

Characteristics of RN Case Management Activities

Patients received an average of 60 minutes/month in RN case management time distributed among the 20 case management categories, adjusted for patient enrollment months. As the activity involving the greatest (in minutes) use of RN time, Document time averaged 26 minutes a month and accounted for 42% of mean monthly case management minutes. This is the same amount of time that RNs spent per patient per month in the following activities: identifying needs and arranging services, monitoring, patient education (Explain) and emotional support. Together the activities of Assess, Monitor: Routine, Explain: Self-Care/Disease and Explain: Medications, Tests/Treatments comprised 24% of total (monthly) case management time. As a whole, the Explain and Monitor categories comprised the largest direct service case management categories, each representing about 22% of total case management time. Monitor: Routine activities accounted for over 15% of all case management time and 70% of all monitoring minutes, while Arrange: Services (all categories) accounted for 13% of total case management time. Providing Emotional Support accounted for a modest 2% of monthly case management time; emotional support may also be provided indirectly through the many other case management activities. This description of the allocation of nursing interventions and RN case management time within the Carle MCCD care coordination model is a key contribution of this study, because it documents the characteristics of chronic care case management in standardized (NIC) nursing

intervention categories within a large, longitudinal study of community-dwelling older adults.

The dominance of the Document activity among the other 19 case management activities may reflect the documentation burden of the MCCD RCT design. The relatively large amount of time allocated to this activity may be decreased in a case management program that is not bounded by RCT design-driven documentation of case management activities down to the five minute increment level. Another important consideration is that allocation of MCCD RN case management time to the Document activity may have consumed case management time that might otherwise have been allocated to patients and perhaps resulted in fewer readmissions.

ED Admission and Readmission Predictors

Characteristics of Case Management Time/Activity Allocated to Patients Experiencing ED Admissions

Identifying needs, arranging services, monitoring services, routine monitoring and arranging personal care services by RN case managers have been identified in this study to be associated with ED admission hazard; all were associated with increased admission hazard, reflecting a likely endogenous relationship between the interventions, case management time, and patients' ED admission hazard. When a time and NDx interaction term was added as a predictor to the Cox model containing NDx and activity time values separately, case manager time spent on the Arrange: Personal Care Services activity was found to be significantly associated with all-cause ED admission risk (p=.0159, OR 1.008). This association is not likely to be causative, but again reflective of the unique

needs and therefore risks of chronically ill older adults who may have personal care assistance gaps or new needs that family caregivers may be unable to fill.

As a component of case managers' care coordination, the arranging of personal care services for patients is likely an indicator of patient physical care needs and potential family caregiver deficits or limitations, as well as a potential pathway for reducing readmission risk. Identifying transportation needs was the only activity significantly associated with decreased ED admission hazard. This finding may reflect the benefit that transportation coordination generates for patients needing PCP services or other health and person service, which may in turn reduce ED admission hazard by improving access to needed care.

In 20 separate Cox models employing each of 20 case management categories as predictor variables, one predictor variable, Monitor: Services (non-clinical services) was associated with ED admission hazard (OR 1.109, p=.009). In Cox models controlling for number of diagnoses, this same monitoring category, together with Monitor: Abnormal Labs/Tests and Monitor: Routine, were associated with increased ED admission hazard (OR 1.022 to 1.113, $p < .10$). In a Cox model controlling for number of diagnoses and a case management time*number of diagnoses interaction (NDx), 4 of 20 case management activities were found to be statistically significantly associated with ED admission hazard, Monitor: Services (p=.009), Identify Needs: Non-Medicare (p=.04), Identify Needs: Transportation (p=.09), and Patient-Specific Travel (p=.06). The interaction term itself was significant in all activity categories except the Identify Needs: Transportation activity and was associated with a 1.4% to 10.1% increase in ED admission hazard odds in 19 categories. This increased ED admission hazard associated with four specific case

management categories (while accounting for a time*NDx interaction) likely reflects an increase in patient service needs that may signal increasing symptom and health status flux, increased health services utilization, frailty, ADL decline or changes in family caregiving resources.

Identify Needs: Transportation was significantly associated with reduced ED admission hazard odds (OR 0.663, p=.09) in the Cox model controlling for number of diagnoses and a time*NDx interaction term described above. This finding suggests that this non-clinical service coordination activity may decrease ED admission hazard by possibly facilitating transportation necessary for primary care delivery and chronic care coordination. This is an important though not unexpected finding; identifying and addressing care delivery needs, including bringing patients to service delivery points, advances care coordination processes, in turn enabling patients to have health and symptom management needs addressed/met. The variable NDx was a significant predictor of ED admission hazard controlling for case management activity in 19 of 20 Cox models, confirming the utility of NDx as a risk-stratifying variable.

Inpatient Admission Subgroups and Case Management Time Associations

Case Management Categories/Time Predictors and Admission and or Readmission Risk

The Carle MCCD patient population was affected on average by 4.5 co-morbid conditions, yet patients' inpatient admission and readmission rates were lower than expected compared to national rates for patients with 3+ chronic diseases. Care coordination intervention associations were documented in the analyses of admission and readmission predictors. In multiple comparisons of different admission subgroups, a greater amount of case management minutes was associated with patient groups that

experienced no admissions compared to those in groups with one or two admissions or two or more admissions. Patients who had no admissions or only one admission received a significant though only slightly higher amount of RN time spent identifying and/or arranging for their Medicare-covered service needs, compared to patient subgroups with higher admission frequencies. These case management activities included identifying and prioritizing patient health needs and identifying new problems needing intervention/care. Minutes of routine monitoring that patients received were also significant and 10% higher on average in patients with no admissions compared to patients with 1-2 admissions. The Monitor activity category alone was not found to be significantly associated with inpatient admission odds in univariate/multivariate models, but was significantly associated with odds of inpatient readmission multivariate models. In Cox models controlling for number of diagnoses (NDx), three of four monitoring categories (except Monitor: Other) were significant (<.10) and associated with ED admission hazard odds ranging from 1.022 to 1.113.

These findings suggest that monitoring activities for patients may themselves avert or link to other activities that may avert inpatient admission, and ED visits may well be one outcome of increased monitoring and also linked to reduced inpatient admission risk. In both Mann-Whitney and multivariate logistic regression analyses, the Identify Need: Medicare case management activity was positively associated with either no/few admissions, or a reduced risk of admission ($p<.05$). This suggests that provider recognition and managing of health needs and problems by RN case managers may be linked to timely interventions, which in turn may reduce risk of unscheduled inpatient admissions.

The timing and targeting of nurse case management was one principle focus of this study. The amount of case management time and the timing of case management interventions following a index inpatient admission (within 30, 60, 90 and 180 days) was determined to be consistently different for patients experiencing only one admission compared to those with 2 admissions. Patients with 2+ admissions were found to have received less Assess time in all time intervals with the exception of the 0-30 days post index admission (all intervals, $p < .05$). Similarly, patients with 2+ admissions were found to have less time in the Identify Needs: Other Non-Medicare category time in all interval categories ($p < .05$) with the exception of the 0-30 days post index hospitalization ($p=.12$) interval. All patients with one admission in all Identify Needs: Medicare category time intervals (30, 60, 90 and 180 days) received more case management time than patients experiencing one or more readmission ($p < .05$). Pre and post admission case management time rates/30 days also differed for patients with one versus 2+ admissions, with patients with 1+ admission routinely receiving more case management time in 34 of 40 pre and post admission comparisons.

The association of case management time in select activity categories for patients experiencing fewer admissions suggests that case management interventions may be protective or beneficial in patients. The findings also suggest that increased case management time provided to patients in selects activity categories did not reduce readmission odds, and that overall only one chronic disease of eight, CHF, could explain an increased readmission odds in the patient subgroup. For patients with no readmissions, a specific mechanism for reducing readmission is unclear. One possible explanation is that patients who experience care coordination that supports effective disease

management and in whom symptom exacerbations are curtailed or in whom health needs are met through effective case management monitoring may as a result experience fewer ambulatory care condition sensitive admissions. RN case management activities that serve to identify and address service needs of chronically ill patients may serve to avert the symptom and clinical condition exacerbations that precede functional decline and increased disease acuity. This finding requires further study and replication of the documented associations.

Final Best Fit Model for Estimating Inpatient Readmission Risk

Assessment and Identify Needs (collapsed subcategories) case management categories were significantly associated with inpatient readmission odds, along with CHF ($p=.02$) in a final best fit multivariate regression model estimating readmission risk. These two case management activity categories patient evaluation, clinical and psychosocial problem identification and synthesis of information, necessary steps in managing patient treatment plans within a care coordination model. Both activities are commonly documented case management activities in the MCCD study, with Assess time averaging 90 minutes/year per person, and Identify Needs averaging 27 minutes a year/person. Identify Needs activities comprise approximately five percent of total annual case management time, while Assessment activities comprise approximately 15%.

After model testing and refinement, one patient primary chronic disease (CHF), and one case management activity category, Assessment, were found to be significantly associated with readmission risk ($OR =2.7$, $p<.05$); the Identify Needs category (including four subcategories of Identify: Personal Care Needs, Identify Transportation Needs, Identify: Non-Medicare Needs, and Identify Medicare Needs) was associated in

the same model with reduced (7% for each minute of Identify Needs time) readmission odds (OR=.93, p=.05). Assess was associated with a 6% increase in log odds of readmission (OR 1.06) for every minute of Assess time.

Time spent assessing health/disease and symptom status would be expected to increase in the presence of increased acuity and complexity and thus be associated with increased readmission risk. Controlling for the most likely primary chronic disease found to be associated with inpatient readmission in this study, CHF, the case management activity of Identify Needs (reflecting synthesis of data from assessment and problem/need identification) was associated with reduced log odds of inpatient readmission. Time spent identifying self-care and clinical support needs to then target nursing and primary care interventions was significantly associated with reduced inpatient readmission odds, controlling for primary chronic disease. This finding reflects expected outcomes of the Chronic Care Model, wherein evidenced-based care structure(s) and processes yield desired outcomes of care. Reduced unscheduled readmission risk is a desired outcome of chronic care management. This is an important finding in terms of the effect of RN case management on readmission risk that bears further study and replication.

Patient Characteristics and Inpatient Admission and Readmission Risk Number of Diagnoses

In this study, number of diagnoses (NDx) was used as control variable in Cox modeling and multivariate logistic regression. In multivariate analyses, number of diagnoses (NDx) were significantly associated with increased risk of readmission in each of the 20 RN case management activity categories. Number of diagnoses was also a significant predictor of ED admission hazard in Cox models with case management

activity variables and time*NDx interaction variables. This finding is consistent with prior research on the utility of simple counts of diagnoses as a tool for risk-adjusting chronic disease populations (Southern, Quan & Ghali, 2004). Patient age, both continuous and categorical, race/ethnicity, gender and urban or rural residence, and number of diagnoses (continuous and categorical) were each not significantly associated with readmission risk in multivariate logistic regression. Number of chronic diseases was, in the case of patients with 6 documented chronic diseases, significantly associated with increased inpatient readmission risk, as was CHF as previously mentioned. Hypertension was associated with a decreased risk of readmission (OR .54, p=.099). The latter diagnosis was the most commonly documented diagnosis for study group patients, with over 40% of patients diagnosed as hypertensive.

RN-Level Associations with Inpatient Readmission

This study documented that individuals RNs were associated in nearly all analyses with reduced readmission risk. In several instances, RNs were associated with increased readmission odds. Multivariate analyses employing individual RN-level case management data revealed significant associations between individual RNs and reduced readmission risk in the case of six RNs (Table 13, Table 14). Six (of 14, including two who had insufficient data, and another who served as reference) individual RN case managers were associated with a 63% to 87% reduction in log odds for inpatient readmission. Multivariate logistic regression including RN IDs and a separate chronic disease categorical predictor variable produced three separate models in which three RN IDs were significantly associated with CHF patient readmissions (RN IDs 4, 118, and 160). Controlling for readmission associated with primary chronic disease/CHF, two of

these RN IDS were associated with a 35% to 40% reduction in log odds of patient readmission, while one RN ID had a 340% increased log odds of inpatient readmission. Since this analysis utilized all-cause, anytime admissions as an outcome measure, additional research is needed to refine the analysis of primary admission diagnoses in combination with underlying primary chronic disease diagnoses and RN case manager-associated readmission risk reduction.

An interaction variable testing the association of a RN ID*Chronic Disease variable was evaluated in a two predictor plus interaction term multiple logistic regression model; the model included an individual RN ID and individual chronic disease variable. Three RN*Disease interactions were identified at a $p>.05$ and $< .10$ level: Diabetes ($p=.054$, OR 10.2), CHF ($p=.075$, OR 8.4) and Lung Disease, ($p=.095$, OR 0.25). In the presence of the CHF Disease*Nurse ID and Diabetes Disease*NurseID interaction variables in the logistic model, there is a documented increase in readmission risk; this significant interaction outcome was attributable to one RN ID (127). These findings may reflect individual variation in this case manager's activities or unmeasured variables involving the patient and suggest that RNs influence patients' readmission risk, both positively and negatively. This important association requires further study and replication.

CHF-focused Analyses

This analysis of between case manager and between time interval differences in case management time allocation revealed subtle differences in how case manager time was allocated to patients experiencing inpatient admission following a specific number of days after a case manager contact. Patients experiencing admission remotely from last

contact with a case manager were allocated more case management time focused on Monitor and Explain: Medications/Treatments activities. Patients experiencing inpatient admission closer in time to the last case manager contact were allocated relatively more time in Explain: Disease/Self Care activity categories. Patients in the 167-402 day interval category received more time in the Arranging Other Services activity category than patients documented in the other three, shorter time intervals. This may mean that patients' risk for admission or readmission is moderated by case manager contacts focused on filling gaps in patients' and caregivers' needs related to personal care and activities of daily living. If this is in fact the explanation for this finding, then targeting specific case management interventions to fill support needs may have a protective effect on patients' readmission risk. Case management targeting and dosing requires much more study and analysis to verify this association.

Descriptive Analysis of Case Management Narrative Records

Analysis of sampled narrative case management records for patients experiencing inpatient admissions revealed the frequency of communication and care coordination provided to patients experiencing inpatient and ED admissions. The documented communications and related care coordination were consistent with evidence-based transitional care processes previously described here. Evidence-based transitional care coordination can reduce readmissions for chronic disease, and this may explain the findings of reduced readmission risk associated with MCCD RN Case Managers.

Study Limitations

A minority of MCCD treatment group patients were readmitted to inpatient acute facilities during the study period. As a result, a smaller number of patients yielded data that could be analyzed through univariate and multivariate logistic regression analysis

and Cox Proportional Hazards modeling. Some of these subgroup analyses, such as the modeling of the association of major chronic disease category with readmission risk, were likely underpowered and therefore did not enable the detection of a treatment effect. A controlled trial with a larger number of readmitted older adults with a range of chronic illness is necessary to assess the interaction of case management interventions and primary chronic diseases.

As can be the case in multisite RCTs, data collection methods may have differed between RN case managers within and between different Carle Healthcare System sites. Use of the drop down menus for nursing assessment and intervention documentation may have varied within and between RN case managers—some RNs may have used one or two of the available 21 activity categories to capture their activity, while others may have used a broader range of categories to capture their care management activities. RN participants in the MCCD RCT operated in different office organizational settings, possessed different educational backgrounds and likely had varying skill sets. This variability may have resulted in variation in RNs' assessment, identification of needs, service coordination, communication with PCPs, patient self-care education, and condition and symptom monitoring, or other characteristics of protocol-guided case management intervention. Some of this potential variability may have been mitigated by the RN and Case Management Assistant training and orientation completed prior to MCCD start-up and the comprehensive policies and procedures developed for MCCD case managers/assistants. It is possible that MCCD documentation by RN Case Managers was incomplete or inconsistent, and that records used for this data analysis do not completely document case management interventions. Patients or caregivers too may

have underreported or misstated health status, symptom management or treatment adherence issues that are documented periodically by case managers. Variability in other types of MCCD data collection is a possible data limitation, in turn influencing findings.

This study analyzed RCT intervention group data in a nested, quasi-case control design, in which intervention subgroups groups were compared to each other and/or the intervention group as a whole. Treatment group subgroups were compared to each other on particular outcomes, rather than compared to the randomly assigned control group or subgroups. This study did not utilize MCCD control group survey, clinical or utilization data. The MCCD control group of chronically ill older adults experienced usual care provided by their PCPS, and their ED and inpatient utilization data was not utilized in this study. Since the study measured the impact of MCCD case management intervention type, timing and time on ED and inpatient outcomes among treatment group strata, a RCT control group comparison was not indicated.

Demographic features of the Carle MCCD treatment group represent a potential study limitation in terms of external validity. The sample population from the original MCCD RCT is relatively ethnically/racially homogenous, with 94% of the treatment and control groups identified as White, and with a fairly high percentage (90%) of individuals with a minimum of a high school education. Findings from this study would need to be interpreted within this sociodemographic frame, since older adults with higher levels of education may be more likely to be activated and motivated at baseline to engage in effective self-care for chronic disease and health promotion.

Use of multiple regression techniques can be limited in application to data from clustered and nested study designs like the MCCD, as the assumption of independent

observations may be violated. This can result in an understatement of standard error and a greater chance of a Type 1 error. Residual analysis, or analysis of error variance, can help identify instances in which assumptions of independent observations may be violated in data sets (Hosmer & Lemeshow, 1989). Normality assumptions can be verified through examination of distributions of residuals, which are expected to be normally distributed. Examination of residuals was completed for the logistic regression analyses and no abnormal distributions of residual were observed. In all statistical analyses described here, p levels up to .10 are considered significant. The decision to define an alpha level of .10 as significant was based on the exploratory nature of this study. The consideration of statistical significance at a p of >.05 to <.10 increases the likelihood of a Type I error, and this is a limitation of this study.

Documentation of patient contacts by RNs and support staff within text documentation records varied in focus and completeness, as well as in the use of medical abbreviation conventions and clinician jargon. The variation in documentation styles may have limited adequate categorization of some entries. In examining contact records for this study, it was possible to identify case management activities in the form of communications and actions before and after scheduled and unscheduled patient admissions and to assess the presence and absence of care coordination by RNs across acute and post acute care settings. Care coordination relating to symptoms and disease, scheduled outpatient services utilization, preventive health maintenance and communications around ED and inpatient admissions were consistently documented in RNs' narrative contact notes. Further study of these care and communication processes that cannot be effectively captured in quantitative analyses could help inform the nature

and impact of nursing interventions in chronic care

The MCCD Care Coordination model expressed in the Carle Clinic MCCD was based in part on the Chronic Care Model (Wagner et al, 1996). This study focused on several aspects of the model, included engaged multidisciplinary healthcare teams, self-management support and use of evidence-based care in a nurse-led case management program. This study did not evaluate other aspects of the Chronic Care Model, including information system use/effectiveness, the level of patient engagement and detailed elements of decision-support.

Conclusions

RN interventions documented in this study, guided by evidence-based chronic care protocols and reflecting the system design/decision-support guidelines that form a segment of the Chronic Care Model (Wagner et al, 2002), reduced ED or inpatient admission or inpatient readmission odd (reduced log odds) in the MCCD study population. Some RNs and intervention time were also associated with increased inpatient and ED readmission odds. This was documented in analyses of individual RN associations with readmission risk in multivariate analysis, including individual RN associations with readmission risk in the presence of primary chronic disease and patient demographic variables. Reduced inpatient admissions were also found to be associated with specific case management activity categories, time (minutes) and pre and post-admission RN-patient contact timing. Patients in the inpatient readmission groups were associated with individual RN interactions with specific diseases, or increased case management time in selected early post inpatient discharge time intervals and in several activity categories. These activity categories included Assess time and Monitor

subcategories. The implications of these impacts of RN case management on patient admissions and readmissions are summarized here.

This study documented that specific case management activities of RNs were significantly associated with readmission. Of these activities, more minutes in the Assess activity category were associated with increased readmission odds in several analyses. Case managers likely increased Assess activity as patient acuity or clinical events so necessitated and in some cases these changes in patient status included inpatient and ED admission/readmission. Identify Needs: Transportation was associated with decreased ED admission hazard, and this may reflect RN intervention activities that promote care continuity, such as getting patients to needed healthcare and support services. This finding indicates that RN interventions, in the form of identifying patient support needs, may ultimately reduce ED admission hazard odds. Identify Needs case management activities and time were also significantly associated with patient subgroups with only one inpatient admission in analyses of timing/amount of case management activities in defined intervals after an index admission and also in case management dosing (rate) comparisons pre and post inpatient admission

Recurrent findings in this study document that chronic CHF places patients at risk of readmission. This finding is consistent with the complexity of this chronic disease and its typical trajectory described in the literature. In spite of this, several RN case managers were associated with reduced readmission risk for CHF patients, controlling for the CHF variable itself. This is an important finding in term of RNs' important role in chronic care management effectiveness and cost-benefit. Analysis of case management time allocated to CHF patients within specific time frames preceding ED or inpatient admissions

revealed significant amounts of time expended in the Assessment, Identify Needs, Explain: Disease/Self-Care, Explain: Medications, and Arrange Services: Medicare interventions, provided over the four different day intervals (Table 22, range 0 to 402 days) evaluated. The amount of case management time allocated to these individual case management categories exceeded the mean time for the average MCCD patient; this may explain the reduced risk of readmission associated with individual RN case managers, and also may indicate the kinds of targeted case management that CHF patients may need and benefit from.

Analysis of CHF patient distribution among case managers and patterns of case management revealed that mean (total time) case management time for patients with primary diagnoses of CHF was not significantly different from case management time allocated to patients with other primary chronic diseases. This similar amount of total case management time may have been a function of similar acuity and need among all patients, efficiency on the part of RN case managers, and/or relatively low acuity among some CHF patients. CHF patients had the highest rate of readmission of all patient subgroups over the study period. This finding suggests an area for further study-- that of increasing targeted case management time for CHF patients and the impact on associated readmission outcomes. CHF patients may require a different combination of case management activities and minutes of RN case management to further impact their readmission risk.

The impact of specific case management activities and timing in CHF patients was further analyzed. Analysis of differences in time allocated to CHF patients in case management activities and the timing of these activities after an index inpatient

admission documented very small but statistically significant ($p < .081$) differences in Assessment, Identify Needs, Arrange Services, and Explain: Disease(s)/Self-Care, Explain: Medications/Treatments, and Explain: Labs/Tests categories. Patients with one inpatient admission received more time in these categories than readmitted patients (2+ admissions) in 30 day intervals up to 180 days post admission. Case management activity in these significant activity categories, which reflect core chronic care coordination processes, may offer a benefit for CHF patients and thus reduce CHF patient readmission odds. The impact of these specific activities and the actual number of minutes of case management intervention that produce decreased readmission odds require further study and replication.

Implications

This study demonstrates the impact that evidence-based, protocol-guided case management by RNs can have on older adult, chronic disease patients' inpatient and ED utilization risk. The documentation of significant associations between individual RNs and reduced and increased readmission odds, controlling for primary chronic disease, is an important finding. Another important finding of this study is that of the type, timing and the amount of case management time and association with readmission outcomes. Further research on how RN case management in chronic disease populations can decrease readmission odds across a range of chronic diseases is needed.

Inpatient readmissions are a substantial portion of annual Medicare costs, and can/do impact patients and caregivers in health status, psychosocial, and economic domains. Averting avoidable hospital admissions is an appropriate goal of chronic care case management because admissions can be costly, promote loss of functional capacity

and conditioning on older adults, and expose patients to stressors and iatrogenic harm that are best avoided, if possible. Hospital readmissions of Medicare patients amount to $15 billion in costs/year (Klein, 2008). The Centers for Medicare and Medicaid Services (CMS) has proposed that three hospital readmission measures be added to the CMS hospital quality measure reporting program, beginning in FY 2010 (CMS, 2008). Further research on the translation of case management effectiveness and cost-benefit findings into health system and payor policies, and the optimal design of supporting structure and processes, is needed to meet patients' needs, improve healthcare provider teams' delivery of healthcare, and meet payor and regulatory quality improvement aims.

These findings do not provide complete clarity regarding how RNs reduced readmission odds on most cases, or increased odds in several cases. The association of case management time and readmission odds identified in this research requires further study. Researchers will continue to be challenged to unbundle the impact of increased case management intervention time from the impact of increased or decreased acuity or complexity of care needs, and the interaction of these two factors. Additional study is needed regarding how best to integrate community-based chronic care management across health care settings, how to measure and monitor the quality of this cross- setting coordination, and how acute and post-acute systems of care can integrate care with a chronic care/care coordination model.

BIBLIOGRAPHY

Agency for Healthcare Research and Quality. (2008). *2007 State Snapshots.* Retrieved 03/26/08, from http://statesnapshots.ahrq.gov/snaps07/index.jsp?menuId=1&state=CA

AHA (American Heart Association). 2005. *Heart Disease and Stroke Statistics, 2005 Update.* Dallas, Tex.: American Heart Association.

Aubert, R. E., Herman, W. H., Waters, J., Moore, W., Sutton, D., Peterson, B., et al., (1998). Nurse case management to improve glycemic control in diabetic patients in a health maintenance organization: A randomized controlled trial. *Annals of Internal Medicine, 129*(8), 605-612.

Bindman A., Grumbach, K., Osmond D., Komaromy, M., Vranizan K., Lurie N., et al., (1995). Preventable hospitalizations and access to health care. *Journal of the American Medical Association, 274*(4), 305-311.

Bodenheimer, T., Wagner, E. H., & Grumbach, K. (2002). Improving primary care for patients with chronic illness; The Chronic Care Model, Part 2. *Journal of the American Medical Association, 288(*15), 1909-1914.

Bodenheimer, T., Wang, M., Rundall, T., Shortell, S. M., Gillies, R. R., Casalino, L., et al., (2004). What are the facilitators and barriers in physician organizations' use of care management processes? *Joint Commission Journal on Quality and Safety, 30*(9), 505-514.

Bodenheimer, T., & Fernandez, A. (2005). High and rising healthcare costs, Part 4: Can costs be controlled while preserving quality? *Annals of Internal Medicine, 143*(1), 26-31.

Boling, P. (1999). The value of targeted case management during transitional care. *Journal of the American Medical Association, 281*(7), 656-657.

Bonomi, A., Wagner, E., Glasgow, R., & VonKorff, M. (2002). Assessment of chronic illness care: a practical tool to measure quality improvement. *Health Services Research, 37*(3), 791-820.

Boockvar, K., Fishman, E., Kyriacou, C. K., Monias, A., Gavi, S., & Cortes, T. (2004). Adverse events due to discontinuations in drug use and dose changes in patients transferred between acute and long-term care facilities. *Archives of Internal Medicine, 164*(5), 545-550.

Boockvar, K., Fridman, B., & Marturano, C. (2005). Ineffective communication of mental status information during care transfer of older adults. *Journal of General Internal Medicine, 20*(12), 1146-1150.

Boockvar, K. & Burack, O. (2007) Organizational relationships between nursing homes and hospitals and quality of care during hospital-nursing home patient transfers. *Journal of the American Geriatrics Society, 55*(7), 1078–1084.

Boult, C., Rassen, J., Rassen, A., Moore, R. J., & Robison, S. (2000). The effect of case management on the costs of health care for enrollees in Medicare Plus Choice plans: A randomized trial. *Journal of the American Geriatrics Society. 48*(8), 996-1001.

Bowles, K.H. (2005). Omaha System in Nursing Research. In K.S. Martin (Eds.), *The Omaha System (2nd Ed.)*. (x). Philadelphia, PA: Elsevier Science.

Bowles, K.H, Foust, J., & Naylor, M. (2003). Hospital discharge referral decision-making: A multidisciplinary perspective. *Applied Nursing Research, 16*(3), 134-143.

Bowles, K. H., Naylor, M., & Foust, J. (2002). Patient characteristics at hospital discharge and a comparison of home care referral decisions. *Journal of the American Geriatrics Society, 50*, 336-342.

Brown, L. D. (1992). Political evolution of federal health care regulation. *Health Affairs, 17*(37), 17-37.

Brown, R., Peikes, D., Chen, A., Ng, J., Schore, J., & Soh, C. (2007). *Evaluation of the Medicare Coordinated Care Demonstration: Findings for the first two years,* (Publication No. 8756-420). Princeton: NJ: Mathematica Public Research, Inc.

Casalino, L., Gillies, R., Shortell, S., Schmittdiel, J., Bodenheimer, T., Robinson, J., et al. (2003). External incentives, information technology and organized processes to improve healthcare quality for patients with chronic disease. *Journal of the American Medical Association, 289*(4), 434-441.

Centers for Medicare and Medicaid Services [CMS]. (2008). *CMS Proposes to Expand Quality Program for Hospital Inpatient Services in FY 2009*. Centers for Medicare and Medicare Services. Retrieved April 14, 2008, from http://www.cms.hhs.gov/AcuteInpatientPPS/IPPS/itemdetail.asp?filterType=none&filterByDID=0&sortByDID=4&sortOrder=descending&itemID=CMS1209719&intNumPerPage=10

Chen, A., Brown, R., Archibold, N., Arliotta, S., & Fox, P. (2000). *Best Practices in Cooordinated Care* (Publication No. 8534-004). Princeton, NJ: Mathematica Policy Research, Inc.

Chiu, W., & Newcomer, R. (2007). A systematic review of nurse-assisted case management to improve hospital discharge transition outcomes for the elderly. *Professional Case Management, 12*(6), 330-336.

Coleman, E. A. (2003). Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. *Journal of the American Geriatrics Society, 51 (4):* 549-555.

Coleman, E., Mahoney, E., & Parry, C. (2005). Assessing the quality of preparation for posthospital care from the patient's perspective. *Medical Care, 43*(3), 246-254.

Coleman, E., Smith, J., Frank, J., Min, S., Parry, C., & Kramer, A. (2004). Preparing patients and caregivers to participate in care delivered across settings: the Care Transitions Intervention. *Journal of the American Geriatrics Society, 52*(11), 1817-1825.

Crawford, A., Fuhr, J., Clarke, J., & Hubbs, B. (2005). Comparative effectiveness of total population versus disease-specific neural networks models in predicting medical costs. *Disease Management, 8*(5), 277-287.

Davidson, M., Castellanos, M., Duran, P., & Karlan, V. (2006). Effective diabetes care by a Registered Nurse: Following treatment algorithms in a minority population. *American Journal of Managed Care, 12*, 226-232.

Davis, K. (2007). Paying for care episodes and care coordination. *New England Journal of Medicine, 356*(11), 1166-1168

Davis, K., Shoen, C., Guterman, S., Shih, T., Schoenbaum, S. C., & Weinbaum, I. (2007). *Controlling Healthcare Spending: What are the Options*? New York: The Commonwealth Fund.

Desai, M., Bogardus, S., Williams, C., Vitagliano, G., & Inouye, S. (2002). Development and Validation of a Risk-Adjustment Index for Older Patients: The High-Risk Diagnoses for the Elderly Scale. *Journal of the American Geriatrics Society, 50*(3), 474-481.

Disease Management Association of America. (2007). Disease Management Defined. *About Disease Management*. Retrieved 3/20/07, from http://www.dmaa.org/dm_definition.asp

Donabedian, A. (1966). Evaluating the quality of medical care. *Milbank Memorial Fund Quarterly, 44*(1), 166-203.

Englehardt, J., McClive-Reed, K., Toseland, R., Smith, T., Larson, D., & Tobin, D. (2006). Effects of a program of coordinated care of advanced illness on patients,

surrogates, and healthcare costs: A randomized trial. *American Journal of Managed Care, 12*(2), 93-100.

Farley, J., Harley, C., & Devine, J. (2006). A comparison of comorbidity measurements to predict healthcare expenditures. *American Journal of Managed Care, 12*(2), 110-117.

Fireman, B., Bartlett, J., & Selby, J. (2004). Can disease management programs reduce costs by improving quality? *Health Affairs, 23*(6), 63-75.

Fisher, E., Staiger, D., Bynum, J., & Gottlieb, D. (2007). Creating accountable organizations: The extended hospital medical staff. *Health Affairs Web Exclusive, 26(1), W44-57.* Retrieved 12/10/2007, from http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=17148490

Forster A., Murff, H., Peterson, J., Gandhi, T. & Bates, D. (2003). The incidence and severity of adverse events affecting patients after discharge from the hospital. *Annals of Internal Medicine, 138(3):*161-167.

Galbreath, A., Krasuski, R., Smith, B., Stajduhar, K., Kwan, M., Ellis, R., et al. (2004). Long-term healthcare and cost outcomes of disease management in a large, randomized, community-based population with heart failure. *Circulation, 110*, 3518-3526.

Garis, R., & Farmer, K. (2002). Examining costs of chronic illness in a Medicaid population. *Managed Care,(August 2002)* 43-50.

Gaskin, D., & Hoffman, C. (2000). Racial and ethnic differences in preventable hospitalizations across 10 States. *Medical Care Research and Review, 57(Suppl 1)*, 85–107.

Greenwald, J., Denham, C., & Jack, B. (2007). The hospital discharge: A review of a high-risk care transition with highlights of a reengineered discharge process. *Journal of Patient Safety, 3*(2), 96-106.

Griffith, J., Alexander, J., & Foster, D. (2006). Is anybody managing the store? National trends in hospital performance. *Journal of Healthcare Management, 51*(6), 392-404.

Grossbart, S. (2006). What's the return? Assessing the effect of "pay-for-performance" initiatives on the quality of care delivery. *Medical Care Research Review, 6*(1 (Suppl)), 29S-48S.

Halasyamani, L., Kripalini, S., Coleman, E., Schnipper, J., van Walraven, C., Nagamine, J., et al. (2006). Transition of care for hospitalized elderly patients: Development of a discharge checklist for hospitalists. *Journal of Hospital Medicine, 1,* 354-360.

Hamner, J.B. (2005). State of the science: Post-hospitalization nursing interventions in congestive heart failure. *Advances in Nursing Science, 28*(2), 175-90.

Henry, S., Holzemer, W., Randel, C., Hsieh, Miler, T. (1997). Comparison of Nursing Interventions Classification and Current Procedural Terminology Codes for Categorizing Nursing Activities. *Journal of Nursing Scholarship*, 29(2):133-8.

Holzemer, W.L. (1994). The impact of nursing care in Latin America and the Caribbean: A focus on outcomes. *Journal of Advanced Nursing*, *20*, 5-12.

Inouye, S. K., Bogardus S.T., Baker, D. I., Leo-Summers, L., & Cooney, L. M. (2000). The Hospital Elder Life Program: a model of care to prevent cognitive and functional decline in older hospitalized patients. *Journal of the American Geriatrics Society, 48*(12), 1697-1706.

Kind, A., Smith, M., Frytak, J., & Finch, M. (2007). Bouncing back: Patterns and predictors of complicated transitions 30 days after hospitalization for acute ischemic stroke. *Journal of the American Geriatrics Society, 55(3), 365-373.*

Klein, S. (2008). In focus: Preventing unnecessary hospital readmissions, 2008. *Quality Matters*, (March/April 2008), pp. 1-3. New York: The Commonwealth Fund.

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (2000). *To Err is Human: Building a Safer Health System*. Washington, D.C.: Institute of Medicine.

Kripalini, S., LaFevre, F., Phillips, C., Basaviah, P., & Baker, D. (2007). Deficits in communication and information transfer between hospital-based and primary care physicians: Implications for patient safety and continuity of care. *Journal of the American Medical Association, 297*(8), 831-841.

Kozak, L., Hall, M & Owings, M. (2001). Trends in Avoidable Hospitalizations, 1980–1998*, Health Affairs*, *20*(2): 225-232.

Institute for Health Improvement. (2007). Chronic Care Management Model [Electronic Version]. Retrieved May 21, 2007, from http://www.ihi.org/IHI/Topics/ChronicConditions/AllConditions/Changes/

Institute of Medicine. (2001). Crossing the Quality Chasm: A New Health System of the Twenty-first Century. Washington, DC: National Academy Press.

Landi, F., Gambassi, G., Pola, R., Tabaccanti, S., Cavinato, T., Carbonin, P.U., et al., (1999). Impact of integrated home care services on hospital use. *Journal of the American Geriatrics Society*, *47*(12), 1430-1434.

Landon, B. E., Wilson, I. B., & Cleary, P. D. (1998). A conceptual model of the effects of health care organizations on the quality of medical care. *Journal of the American Medical Association, 279,* 1377-1382.

Linden, A. (2006). What will it take for disease management to demonstrate a return on investment? New perspectives on an old theme. *American Journal of Managed Care, 12*(4), 217-222.

Lynch, M., Estes, C., & Hernandez, M. (2005). Chronic care initiatives for the elderly—can they bridge the Gerontology-Medicine Gap? *Journal of Applied Gerontology, 24*(2), 108-124.

Lynne, J. & Adamson, D. (2003). *Living well at the end of life: Adapting health care to serious chronic illness in old age*, Santa Monica, CA: RAND Health.

McGlynn, E. Asch, S.M., Adams, J., Keesey, J, Hicks, J, DeCristofaro, A., & Kerr, E.A. (2003). The quality of healthcare delivered to adults in the U.S. *New England Journal of Medicine, 348* (26), 2635-45.

Mitchell, P. H., Ferketich, S., & Jennings, B. M. (1998). Quality health outcomes model. *Image Journal of Nursing Scholarship, 30*(1), pp 43-46.

Moore, C., Wisnivesky, J., Williams, S., & McGinn, T. (2003). Medical errors related to discontinuity of care from an inpatient to an outpatient setting. *Journal of General Internal Medicine. 18*, 646-651.

Murtaugh, C., & Litke, A. (2002). Transitions through post acute and long-term care settings: Patterns of use and outcomes for a national cohort of elders. *Medical Care, 40*(3), 227-236.

National Center for Health Statistics, U.S. Department of Health & Human Services, Centers for Disease Control and Prevention (2006). *National Hospital Discharge Survey 2004 Annual Summary; Data from the National Healthcare Survey*. Hyattsville: MD.

Naylor, M. (2000). A decade of transitional care research with vulnerable elders. *Journal of Cardiovascular Nursing, 14*(3), 1-14.

Naylor, M. Brooten, D., Campbell, R., Maislin, G., McCauley, K., & Schwartz, J. S. (2004). Transitional care of older adults hospitalized with heart failure: A randomized controlled trial. *Journal of the American Geriatrics Society, 52*(5): 675-684.

Naylor, M. D., Campbell, R. Jacobsen, B. S., Mezey, M. D., Pauly, M. V., Schwartz, J. S., et al., (1999). Comprehensive discharge planning and home follow-up of

hospitalized elders: A Randomized Clinical Trial. *Journal of the American Medical Association, 281(7):* 613-620.

Newcomer R., Maravilla V., Faculjak P., & Graves, M.T. (2004). Outcomes of preventive case management among high-risk elderly in three medical groups: a randomized clinical trial. *Evaluation and the Health Professions, 27*(4), 323-348.

Norris, S., Nichols, P., Casperson, C., Glasgow, R., Engelgau, M. Jack, C., et al., (2002). The effect of case management and disease management for people with diabetes. *American Journal of Preventive Medicine*, *22*(4S), 15-38.

Ofman, J. J., Badamgarav, E., Henning, J. M., Knight, K., Gano Jr, A., Levan, R. K., et al., (2004). Does disease management improve clinical and economic outcomes in patients with chronic diseases? A systematic review. *American Journal of Medicine, 117*(3), 182-192.

Omaha System (2002). Problem classification scheme, para.1. Retrieved December 10, 2007, from http://www.omahasystem.org/shmprob.htm

Page, S. (2003). "Virtual" health care organizations and the challenges of improving quality. *Healthcare Management Review, 28*(1), 79-92.

Porter, M. E., & Teisberg, E. O. (2006). *Redefining health care: Creating value-based competition on results*. Boston: Harvard Business Publishing.

Quality Matters: Hospital Readmissions. The Commonwealth Fund, 29, March/April 2008. New York: The Commonwealth Fund.

Reuben, D. (2007). Better care for older people with chronic diseases: An emerging vision. *Journal of the American Medical Association*, *298(*22):2673-2674.

Rich, M. W., Beckham, V., Wittenberg, C., Leven, C. L., Freedland, K. E., & Carney, R. M. (1995). A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. *New England Journal of Medicine*, *333*(18), 1190-1195.

Rundall, T., Shortell, S. & Alexander, J. (2004). A theory of physician-hospital integration: Contending institutional and market logics in the health care field. *Journal of Health and Social Behavior,* 45(Extra Issue): 102-117.

Russo, C.A., & Elixhauser, A. (2006). Hospitalizations in the elderly population, 2003. Statistical Brief #6. Agency for Healthcare Research and Quality, Rockville, MD. Retrieved December 1, 2007, from http://www.hcup-us.ahrq.gov/reports/statbriefs/sb6.pdf

Russo, C. A., Jiang, H. J., & Barrett, M. *Trends in Potentially Preventable Hospitalizations among Adults and Children, 1997-2004. (*August 2007). HCUP Statistical Brief #36. Agency for Healthcare Research and Quality, Rockville, MD. Retrieved December 1, 2007, from http://www.hcup-us.ahrq.gov/reports/statbriefs/sb36.pdf

Schmittdiel, J., Shortell, S., Rundall, T., Bodenheimer, T. & Selby, J. (2006). Effect of primary care orientation on chronic care management. *Annals of Family Medicine, 4*(2), 117-123.

Schrader, C. (2007).[MCCD Treatment and Control Group Indicator Data]. Unpublished data. Carle Clinic Association.

Schumacher, K., Beck, C., & Marren, J. (2006). Family caregivers. Caring for older adults, working with their families. *American Journal of Nursing, 106*(8), 40-47.

Sherman, F. T. (2006). Don't let transitional care fall through the cracks: Stopping human and system errors between institutions. (Editorial). *Geriatrics, 61*(4), 9.

Shortell, S., & Rundall, T. (2003). Physician-Organization Relationships: Social Networks and Strategic Intent. In S. Mick & M. E. Wyttenbach (Eds.), *Advances in Health Care Organization Theory* (pp. 141-173). San Francisco: Jossey-Bass.

Shortell, S., Marsteller, J., Lin, M., Pearson, M., Shin-Yi, W., Mendel, P., et al. (2004). The role of perceived team effectiveness in improving chronic illness care. *Medical Care, 42*(11), 1040-1048.

Southern, D.A., Quan, & Ghali, D. A. (2004) Comparison of the Elixhauser and Charlson/Deyo methods of comorbidity measurement in administrative data. *Medical Care, 42*(4):355-60.

Spehar, A., Campbell, R., Cherrie, C., Palacios, P., Scott, D., Baker, J., et al. (2005). *Seamless Care: Safe Transitions from Hospital to Home.* (AHRQ Publication Nos. 050021 (1-4)). Rockville: MD: Agency for Healthcare Research and Quality.

Stuck, A. E., Siu, A. L., Weiland, G. D., Adams, J., & Rubenstein, L. Z. (1993). Comprehensive geriatric assessment: A meta-analysis of controlled trials. *Lancet, 342*, 1032-1036.

Sweeney, L., Halpert, A., & Waranoff, J. (2007). Patient-centered management of complex patients can reduce costs without shortening life. *American Journal of Managed Care, 13*(2), 84-92.

Tang, P., & Lansky, D. (2004). The missing link: Bridging the patient-provider health information gap. *Health Affairs, 24*(5), 1290-1295.

Thorpe, K., & Howard, D. (2006). The rise in spending among Medicare beneficiaries: The role of chronic disease prevalence and changes in treatment intensity. *Health Affairs*, *25*: w378-w388. Retrieved 12/6/06, from http://content.healthaffairs.org/cgi/content/abstract/hlthaff.25.w378

Tsai, A., Morton, S., Mangione, C., & Keller, E. (2005). A meta-analysis of interventions to improve care for chronic illnesses. *The American Journal of Managed Care, 11(8)*, 478-488.

Vladeck, B. C. (2001). You can't get there from here: obstacles to improving care of the chronically ill. *Health Affairs, 20*(6), 175-179.

Wagner, E. H., Austin, B. T., & VonKorff, M. (1996). Improving outcomes in chronic illness. *Managed Care Quarterly, 4*(2), 12-25.

Wagner, E. H., Davis, C., Schaefer, J., Vonkorff, M., & Austin, B. T. (1999). A survey of chronic disease management programs: Are they consistent with the literature? *Managed Care Quarterly, 7*(3), 56-66.

Wagner, E. H., Austin, B. T., Davis, C., Hindmarsh, M., Schaefer, J., & Bonomi, A. (2002). Improving chronic illness care: Translating evidence into action. *Health Affairs, 20*(6), 64-78.

Walsh, M., Simpson, R., Wan, G., Weiss, T., Alexander, C., Markson, L., et al. (2002). Do disease management programs for patients with coronary heart disease make a difference? Experiences of nine practices. *American Journal of Managed Care, 8*(11), 937-946.

Weinberg, D. B., Lusenhop, R. W., Gitell, J. M., & Kautz, C. M. (2007). Coordination between formal providers and informal caregivers. *Health Care Management Review, 32*(2), 1-10.

Weingarten, S., Henning, J., Badamgarav, E., Knight K, Hasselblad V, Gano, A., et al. (2002). Interventions used in disease management programmes for patients with chronic illness---which ones work? Meta-analysis of published reports. *British Medical Journal, 325*, 925-928.

Wennberg, J., Fisher, E., Skinner, J., & Bronner, K. (2007). Extending the P4P agenda, Part 2: How Medicare can reduce waste and improve the care of the chronically ill. *Health Affairs, 6*(6), 1576-1585.

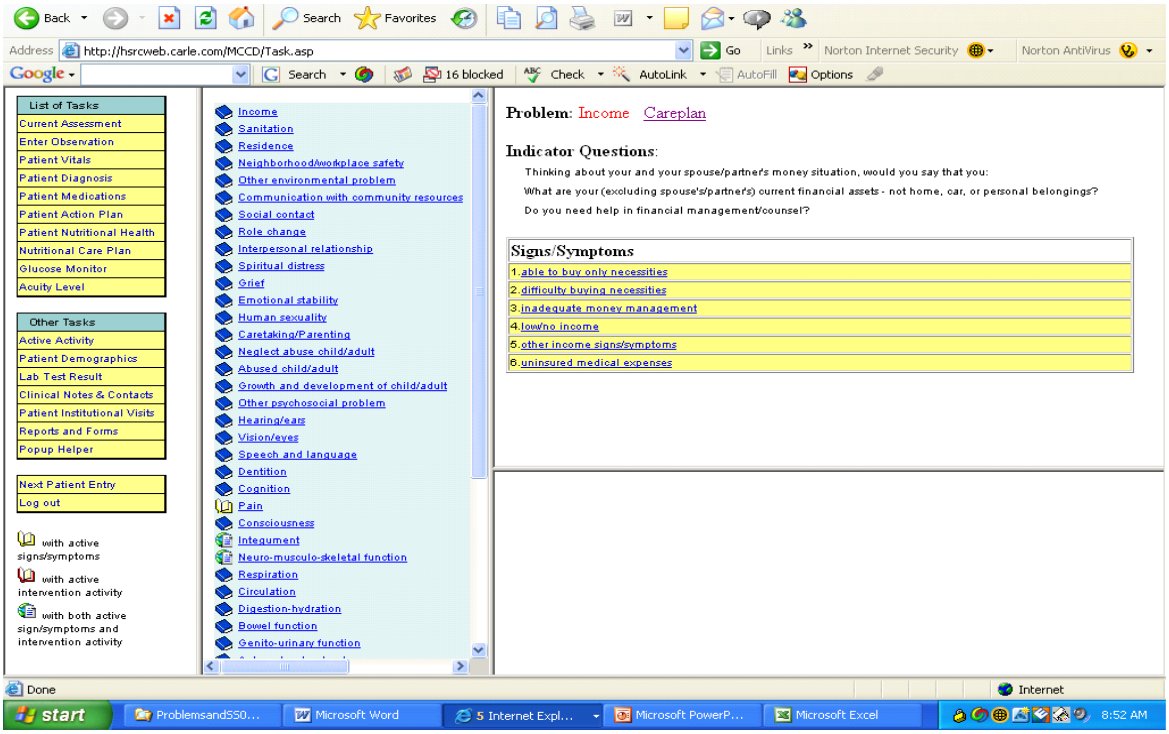
Wheeler, J. C. (2003). Can a disease self-management program reduce health care costs? The case of older women with heart disease. *Medical Care, 41*(6), 706-715.

Yegian, J. M. (2006). Coordinated care in a 'Consumer-Driven' health system. *Health Affairs, 25*(6), w531-w536. .

Zinn, J. & Mor, V. (1998). Organizational structure and the delivery of primary care to older Americans. *Health Services Research. 33,* (2, Pt 2): 354–380.

Appendix A

MCCD Case Management Information System Drop Down Menu



F*igure A1.* MCCD Case manager care planning menu example, drop down menu

Appendix B

Table B1

MCCD ED, Procedure, Encounter and Inpatient Case Management Coordination Activities

imary s	Episode Dx/symptoms	IP Admit month/year	ED Admit month/year	Contact with acute hospital staff noted	Contact with PCP noted	Contact with patient or caregiver	Issues	Interval (days) between ED or DC/transfer and pt/cg* contact
	Chest Pain (CP), Unknown Origin		11/22/02			11/27-Pt	Meds, ADLs	5 day
	Severe CP		3/5/04			3/8-pt	Symptoms, Meds	3 days

Abbreviations Index:

Tc=Telephone call
Sxs=Symptoms
p=Inpatient
Ov=Office visit
Hv=Home visit
ADLs=activities of daily living
CG=caregiver
HF=Heart Failure
DM=Diabetes
CG=Caregiver
Pt=Patient
CP=Chest Pain
VM=Voice Mail
DP=Discharge Planning
PCP=Primary Care Provider
CHF=Congestive Heart Failure
Sxs=Symptoms
SOB=Shortness of Bread
c/o=Complaint of
ARF=Acute RenalFailure
Dx=Diagnosis
CAD=Coronary Artery Disease
DC=Discharge
CA=Cancer
Cath=Catheterization

l imary s	Episode Dx/symptoms	IP Admit month/year	ED Admit month/year	Contact with acute hospital staff noted	Contact with PCP noted	Contact with patient or caregiver	Issues	Interval (days) between ED or DC/transfer and pt/cg* contact
	CP		12/3/04			12/5/04-pt		
	CP		8/23/04			08/23/04-cg		1 day
	Dizziness/lethargy		8/2//06			8/3/06-cg		1 day
	Fall@ Home with LOC	8/2/06		8/10/06-ip visit	8/3/06	08/10/06-cg; 8/11/06 hv; 8/13/06 tc pt; 8/16/06 tc pt		1 day
	Pacer insert	11/8/07				11/8/07;		1 day
	""		3/7/07			3/7/07-cg;l 3/9/07-pt; 4/4/07-pt		1 day

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imary s	Episode Dx/symptoms	IP Admit month/year	ED Admit month/year	Contact with acute hospital staff noted	Contact with PCP noted	Contact with patient or caregiver	Issues	Interval (days) between ED or DC/transfer and pt/cg* contact
	CHF/Mild Cognitive Impairment	1/22/06		1/24/06; VM; 1/25/07 Vm for DP RN; 1/26/06-inpt visit; 1/27/06, VM; & tc contact with inpatient DP RN	1//25/06	1/24/06 in pt visit-pt; 1/25/06-cg	Sxs, PCP follow-up	2 day

Abbreviations Index:

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imary s	Episode Dx/symptoms	IP Admit month/year	ED Admit month/year	Contact with acute hospital staff noted	Contact with PCP noted	Contact with patient or caregiver	Issues	Interval (days) between ED or DC/transfer and pt/cg* contact
	Cellulitis-lower extremity; anemia			6/16/05		6/17/05 ip vs, pt6/22/05-pt, hv	Wound care, meds, sxs	1 day
	Pacer insert		10/ 8 05			10/20/05 tc; 10/21/05 hv pt/cg	SS condition,	11 days

Abbreviations Index:

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Appendix C

Cox Models Estimates of Inpatient Admission Hazard

Cox model analysis of the association of types of case management and amount of case management minutes with hazard of inpatient admission was completed. Case management time in each of twenty one categories was separately analyzed with predictor variables representing each of 21 time categories, and again with type/time amount and number of diagnoses added as a predictor of risk of inpatient admission.

Inpatient Admissions

Monitor: Services and Monitor: Abnormal Results were statistically significantly associated with hazard of inpatient admission ($p < .05$):

- Every additional minute of case management Assess time was associated with a 1.3% increase in hazard of hospitalization ($p = .024$). This category includes case manager time spent in contacts with patients addressing multiple domains or assessment of multiple, specific patient problems; time spent with providers or other contact persons discussing multiple, specific patient needs or addressing multiple, specific patient problems; time spent reviewing information (e.g., health questionnaire/self assessment responses, medical records, notes, laboratory or test results, etc.) on a specific patient. The category does not include time spent recording patient specific information into electronic systems, records or reports. Time spent researching a disease, drug, treatment, or available resources for a specific patient is recorded as patient specific Documentation.

- Every additional minute of Monitor: Services was associated with a 4% increase in inpatient admission hazard (p=.0148). This activity category includes monitoring service use during a patient contact (for example, that the patient kept a scheduled visit, or received Meals on Wheels). Monitor: Routine, a separate category, was found to be associated with ED admission hazard in separate Cox models discussed in the Results section of this paper.

- Every additional minute of case management monitoring of items/issues other than services or abnormal results (Monitor: Other) was associated an 8.3% increase in inpatient admission hazard (p=.0132). This case management category includes follow-up with the patient on a specific problem other than services or Abnormal Results.

- Every additional minute of case management monitoring of abnormal lab results (Monitor: Abnormal Labs/Tests) was associated with a 3.4 % increase in inpatient admission risk (p=.049). This case category includes follow-up with the patient after receiving abnormal results from a test, procedure, or medical marker (such as blood pressure or weight).

- When a number of diagnoses variable (NDx) was added to the regression model for each of the 20 Case Management categories, the variable NDx was associated with increased admission hazard in each case management activity category

($p<.0001$ to .0015). Admission hazard (risk) ranged from 4% to 14.4 % among the significant 20 activity categories.

Kaplan Meir survival curves by major chronic disease diagnosis were completed for inpatient admission hazard, is displayed in Figure 3.1 below. The Kaplan-Meier curve denotes what has the high risk of CHF documented in other aspects of this study, with admission hazard for CHF patients is the second highest of all eight categories. Relatively higher admission hazard is also displayed by patients with primary diagnoses of CAD and Atrial Fibrillation, and relatively lower admission hazard of patients with Hyperlipidemia, Diabetes and Hypertension. Of note is the primary chronic diagnosis group with the shortest time (highest hazard) to ED inpatient admission, Renal disease; this diagnosis was an initial enrollment exclusion diagnosis, though patients may have enrolled and subsequently developed or been diagnosed with chronic renal failure. Chronic Renal insufficiency, a precursor of renal failure, is a common co-morbid condition of CHF

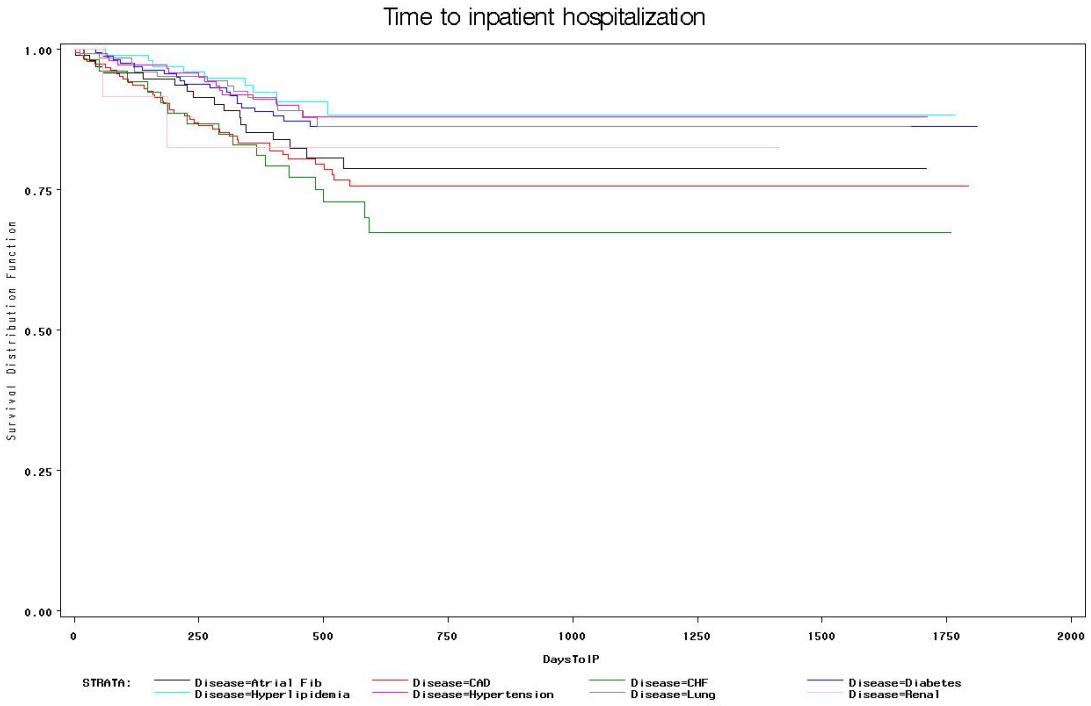

Figure C1. Inpatient admission hazard by major chronic disease

Appendix D

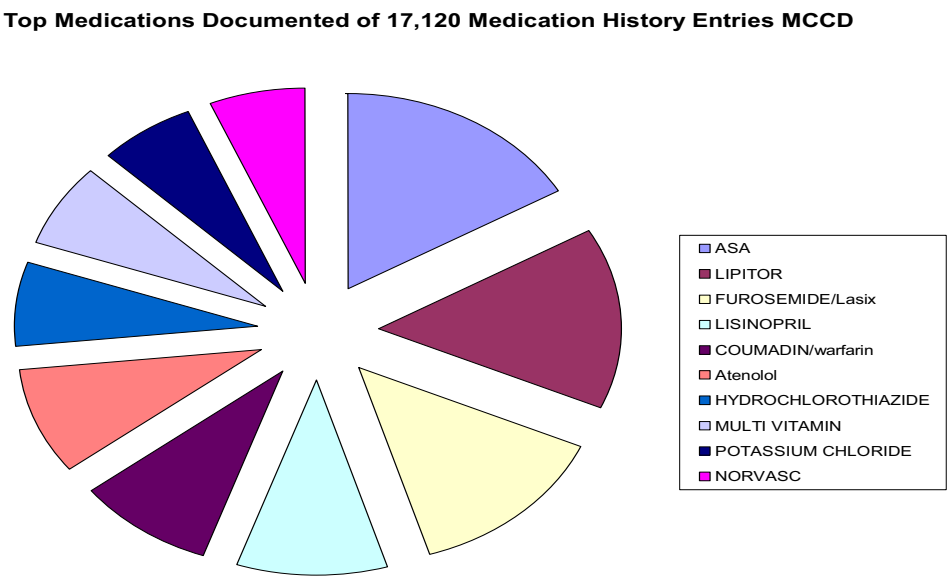

Figure D1. Top 10 Medications documented for MCCD patients (sample of n =17, 120 Medication History Records)

Appendix E

MCCD Time and Activity Reporting Procedure, with Case Management Activity Definitions

Time and Activity Reporting Procedure

Back to Manual Index

Back to Outcome Index

Subject: Nurse Partner and Case Assistant Time/Activity Reporting

Revised: 04/17/06

Statement of the Policy:

A. Each Nurse Partner and Case Assistant completes one time sheet for each day worked or paid. A time sheet is completed for paid and unpaid time off from regular work hours. For consecutive days off, the dates and total time off can be noted on one time sheet.

B. The time sheet is completed throughout the workday to ensure accuracy of data and accountability for activities and hours worked.

C. Record Author Name (Last Name, First Name) in first row.

D. Record Date (mm/dd/yy) in first row.

E. Each contact with a Treatment Group Patient or another person regarding a Treatment Group Patient is recorded on a separate line. Activities completed within the same contact for the same patient can be recorded on the same line.

F. Enter name of each Treatment Group Patient with or for whom the contact or other activity was completed. Note: Contacts or activities related to an intake or intake activities are recorded in the Intake section as Non-patient Specific Activity.

G. Enter Patient Last Name, First Name (John Doe = Doe, John). If contact is with caregiver acting as proxy on behalf of patient enter name of Patient.

H. Enter the Patient's Carle Clinic Association number (CCA#)

I. Contact With - Enter appropriate descriptor code from “Contact Persons List.” See Contact Persons List, Definitions and Codes. For patient specific activities that do not involve a contact (Patient Specific Documentation or Patient Specific Travel) record an X.

J. Did You Initiate Contact With Patient? –Enter appropriate Code:

- Y=Yes, Person contacted is the patient (Code for “Contact With” = “P”) and the Nurse Partner or Case Assistant initiated the contact with the Patient (or caregiver acting as proxy on behalf of patient)

- N=No, Person contacted is the patient (or caregiver acting as proxy on behalf of patient) (Code for “Contact With” = “P”) and the Patient (or caregiver acting as proxy on behalf of patient) initiated the contact. Note that returning a patient’s call (or that of a caregiver acting as proxy on behalf of patient) should be coded as “N”.

- X=Not Applicable, Contact did not involve the patient or caregiver acting on behalf of the patient (i.e., Person Contacted was not the Patient; Code for “Contact With” is not “P”)

K. How/ Where? - enter appropriate Code:

- T=Telephone; completion of a telephone call, does not include leaving telephone or voice messages

- OV=Office Visit Other; in physician office, other office or community setting (e.g. community center, adult day care, church, restaurant, etc) for other than a TC or CV

- CV=Collaborative Visit; completion of a combined medical, nursing and patient self-assessment and development of a plan of care. Completed by a physician/midlevel provider, nurse partner and patient in the office setting. (Person Contacted for CV is the Patient; Code for “Contact With” is “P”)

- TC=Team Conference: Completion of a conference between a nurse partner and a physician in the office setting to coordinate activities of patient care. Other providers may or may not be present. (Person Contacted TC is the Coordinated Care Team, i.e., Nurse Partner and Physician; Code for “Contact With” is “CC”)

- HV=Home Visit; in patient or caregiver’s residence, includes assisted living facilities. Visits with patients in another provider “office” (e.g. community center, adult day care, etc.) are recorded as OV.

- HS=Hospital Visit; in acute care setting

- NH=Nursing Home Visit; in nursing home or other non-hospital institutional care setting;

- E=Electronic Scheduling System: used when scheduling labs or appointments for patients and for faxing authorizations to service providers.

- M=Mail: Individual mail contact in lieu of telephone call to individuals who do not have a telephone. Does not include written confirmation of topics that were discussed in person (i.e. careplans, educational information). Must have two way communication.

- Em=E-mail: Individual two-way communication via e-mail in lieu of telephone contact. Also for two-way communication via electronic medical record (e.g., electronic communication via clinical message feature in IC-Chart). Note: Recording information in the electronic medical record that does not involve two way communication is recorded as Patient Specific Documentation.

- X=Not Applicable: Activity did not involve contact with another. Use only if Patient Specific Documentation and/or Assessment Time spent reviewing information (e.g., health questionnaire/self assessment responses, medical records, notes, laboratory or test results, etc.) on a specific patient is the only activity recorded on the line.

L. *Record time spent in 5 minute increments in appropriate column for activity type.*

M. Assess - Process undertaken to determine the patient's physical, mental, and social condition and needs. Assessment typically occurs on initial contact with the patient, after an incident, or at periodic intervals. Assessment tools or checklists are often used during an assessment contact or activity.

Assessment includes:

- Time spent in contacts with patients addressing multiple domains or assessment of multiple, specific patient problems.

- Time spent with providers or other contact persons discussing multiple, specific patient needs or addressing multiple, specific patient problems.

- Time spent reviewing information (e.g., health questionnaire/self assessment responses, medical records, notes, laboratory or test results, etc.) on a specific patient. Does not include time spent recording patient specific information into electronic systems, records or reports. Time spent researching a disease, drug, treatment, or available resources for a specific patient is recorded as Patient Specific Documentation.

If in the course of assessing, during a patient contact or contact with a provider or other person, 1) a service need is identified or 2) service arrangements are made or discussed, time should also be recorded in 1) Identify Service Needs and/or 2) Arrange Services.

If only one problem is addressed in a contact with the patient and the contact was not planned and not initiated by the Nurse or CA, time should be recorded in Identify Service Needs rather than Assess.

If only one problem is addressed in a contact with the patient and the contact was planned and was initiated by the Nurse or CA, time should be recorded in Monitoring rather than Assess.

N. Identify Service Needs – A need for service is identified during a patient contact or contact with a provider or other person. Usually related to a specific new or previous problem. May include identification of the need for additional assessment or other Nurse or CA service.

- *Personal Care/Homemaker/Meals - Identify a need for Personal Care/Homemaker/Meal*

- *Transportation - Identify a need for Transportation service*

- Other – Non-Medicare - Identify a need for a non-Medicare Service (other than Transportation or Personal Care/Homemaker/Meals). If service is not expected to be covered by Medicare it is considered to be a non-Medicare Service; Nurse or CA service is a Non-Medicare Service.

- Medicare - Identify a need for a Medicare Service– if service is expected to be covered by Medicare it is considered to be a Medicare Service

O. Arrange Services –Arrange for or discuss arrangements for the provision of a service during a patient contact or contact with a provider or other person.

- *Personal Care/Homemaker/Meals - Arrange for or discuss arrangements for the provision of Personal Care/Homemaker/Meal service*

- *Transportation - Arrange for or discuss arrangements for the provision of Transportation*

- Other – Non-Medicare - Arrange for or discuss arrangements for the provision of a non-Medicare service (other than Transportation or Personal Care/Homemaker/Meals). If service is not expected to be covered by Medicare it is considered to be a non-Medicare Service; Nurse or CA service is a Non-Medicare Service.

- Medicare - Arrange for or discuss arrangements for the provision of a Medicare service – if service is expected to be covered by Medicare it is considered to be a Medicare Service

P. Explain/Educate: Giving verbal and/or written information customized to the specific patient. Does not include time spent in preparation of written materials or preparation of individual mailings (See Patient Specific Documentation). Does not include mass mailings (See Office Operations) or activities performed during a group/class.

- Disease/Self-Care – Giving verbal and/or written information customized to the specific patient on disease symptoms, self-care, behavior modification including diet, exercise, smoking, drinking, stress management, or self-advocacy (for example, how to ask a doctor questions)

- Labs/Tests/Procedures/Therapies - Giving verbal and/or written information customized to the specific patient on results or procedures

- RX - Giving verbal and/or written information customized to the specific patient on how to take medications; importance of medication; common side effects, etc.

- Other - Giving verbal and/or written information customized to the specific patient on topics other than Disease/Self Care, Labs/Tests/Procedures/Therapies and Medications

Q. Monitor: Routine calls and checks with patient.

- Routine - Refers to planned, regularly scheduled (routine or periodic) calls to check-in, on a general level, with patients. No specific problem is addressed. For example, one might call the patient to ask how the patient is doing. Completion of a monitoring phone call is recorded here. If one discovers a problem during routine monitoring, time should also be recorded in Assess or Identify Service Need. If a routine patient contact is made to address specific problem(s) other than Services or Abnormal Results, time should be recorded in Monitor: Other

- Services - Monitoring service use during a patient contact (for example, that the patient kept a scheduled visit, or received Meals on Wheels)

- Abnormal Results - Follow-up with patient after receiving abnormal results from a test, procedure, or medical marker (such as blood pressure or weight).

- Other - Follow-up with patient on a specific problem other than Services or Abnormal Results.

R. Emotional Support - Therapeutic listening during a patient contact to address the patient's emotional or social needs. May include guidance, counseling, and other supportive measures to assist with coping.

S. Patient Specific Documentation– Includes the following: completion of case notes; recording information provided by patient or other providers; preparation of reports for physician and other providers; documenting and updating assessment and careplan information; recording discussions with patients, physicians and other providers; preparation of patient specific educational plan and materials. Includes time spent researching a disease, drug, treatment, or available resources for a specific patient. Do not include documentation related to an intake or intake activities. Documentation related to an intake or intake activities is recorded as time spent in the Intake section as a Non-patient Specific Activity.

T. Patient Specific Travel – Travel to and from a visit with a patient. If the visit is not completed, record travel time in non- patient specific Meetings/Education/Travel. Patient Specific Travel time cannot be the only activity recorded for a contact, another activity must also be recorded on the same row. Do not include travel related to an intake or intake activities. Travel related to an intake or intake activities is recorded in the Intake section as a Non-patient Specific Activity.

U. Contact Time/Total Patient Specific Time: Total time spent in Patient Specific contacts/activities (i.e., items through M through T above). The sum of "Total Time" in minutes from the last column of the Time/Activity Report form.

V. For non-patient specific activities, record total time spent for the day on the appropriate line(s) provided at bottom of page for the following :

- Patient Classes/Groups– Record time spent with multiple patients in patient classes or groups. Time spent arranging or preparing for patient classes/groups is recorded as Office Operations. Time spent with individual patients before, during or after a class or group (e.g., BP taken; weight, one on one discussions, etc.) is recorded as patient specific time with the setting as OV other.

- Medical Director – Record time spent discussing/meeting with an MCCD medical director about MCCD program. Includes time spent discussing reports or operational procedures. Do not include time spent discussing individual patients.

- Intake – process of assisting with marketing, facilitating enrollment and assisting patient completion of application, intake, and enrollment forms. Include all intake related activities in this category such as office operations, reporting, travel and documentation.

- Office Operations - Includes: Mass mailings to patient groups. *Non patient specific* mail, e-mail, v-mail, work organization, general caseload work, planning, sending, ordering or receiving clinic or program charts, running reports from computerized data bases/programs, copying or filing forms and paperwork, requesting or maintaining office and nursing supplies and equipment.

- Meetings/Education/Travel - *Non patient specific* Carle meetings, HSRC meetings and staff meetings, staff education, seminars, meetings with non HSRC staff, meetings with MCCD Medical Directors, meetings with other providers or agencies, travel to and from meetings and education.

- Time Off – Minutes of paid or unpaid absences during the hours that you normally work (e.g. holidays, sick time, vacation, etc.).

- Total Non Patient Specific Time – The sum of minutes spent in patient Classes/Groups, Medical Director discussions, Intake, Office Operations, Meeting/Education/Travel and Time Off.

- Total TAR Time – The sum of minutes spent in Patient Specific Time and Non Patient Specific Time. Should equal the total minutes worked that day plus any time off.

W. Nurses and CAs review, sign and submit time sheets at least weekly to HSRC data staff.

X. Time sheets are entered daily (Monday – Friday) by HSRC data staff within two weeks of their submission.

Y. Data entry staff log and track Time/Activity form receipt and maintain records of all data entries and data corrections made.

Z. Data entry staff contacts Nurses and CAs and consult CMIS, scheduling and billing systems, and the clinical director for clarification as necessary.

AA. Data entry staff notifies administrative staff of problems or apparent inconsistencies in data

BB. Data entry staff generate summary reports for administrative review as requested.

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