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Comorbidities In the Context of Care Transitions

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Introduction

An increasing number of Americans live with multiple chronic conditions. The proportion of individuals living with two or more multiple chronic conditions (herein termed comorbidities) grew from 24% to 28% between 2001 and 2006. In addition, the percentage of Medicare beneficiaries living with 5 or more comorbidities increased from 37% to 50% between 1987 and 2002.¹ The growing number of individuals living with comorbidities continues to drive the growth of the United States health care costs.² Individuals with comorbidities account for over 60% of total health care expenditures and 98% of Medicare expenditures. Furthermore, individual expenditures increase with each additional chronic condition.³ Hence the increasing number of individuals with comorbidities challenges both the current health care system and the fiscal status of the United States.^{4–6}

Individuals with comorbidities often experience transitions between health care settings. These transitions, characterized as a change in the level and location of care with a hand-off from one health care team to another,⁷ often lead to conflicting instructions, medication discrepancies, and lack of follow-up appointments with primary care providers after hospitalizations.^{8–10} This fractured and inappropriate care may be unaligned with individuals' goals and preferences, resulting in poor outcomes.¹¹ Current trends within the

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United States health care system, such as the focus on specialization and single disease management programs, also contribute to the likelihood of adverse outcomes for individuals with comorbidities undergoing transitions.

Past scholars have generated a body of research addressing the impact of comorbidities on patients' outcomes. These scholars concentrated on the concept of comorbidity to promote methodological rigor in research and advance the clinical care of complex patients. In 1970, Feinstein published a sentinel paper presenting a scholarly discussion regarding the complex interrelationship of comorbidities and its effect on individual outcomes.¹² He defined comorbidity as any additional condition that exists before or occurs during the clinical course of an index condition. Feinstein posited that comorbidities influence patients' clinical course. Hence, he developed a risk classification system based on location and chronological order of symptoms and events to guide therapeutic decisions and enhance scientific rigor.

Researchers have built on Feinstein's work, attempting to clarify the relationship between comorbidities and patient outcomes. Most researchers have conducted concept analyses or constructed classifications of comorbidities to provide a framework for research and practice. These analyses have led to the expansion of the definition of comorbidities, including terms such as multimorbidity, to acknowledge the increasing phenomenon of multiple co-existing conditions.¹³ Resulting frameworks have incorporated technological advances to portray comorbidities as an interface between biological processes and patient outcomes.^{10,13} Recently, experts have developed measurement frameworks targeted towards improving the quality of care for individuals with comorbidities that include organizational and patient outcomes.^{11,14}

Although, this body of scholarly work has advanced the science of comorbidities, the research has yet to address the impact of comorbidities on the experience and outcomes of individuals throughout the frequent transitions that occur between care settings. Delineating the theoretical underpinnings of the phenomenon of the individual with comorbidities undergoing care transitions could provide a framework for future research to identify both individual and system intervention targets to improve the quality of care. To elucidate the theoretical underpinnings of the phenomenon of individuals with comorbidities undergoing transitions, we used Dimensional Analysis, a qualitative approach, to analyze words and phrases extracted from empirical literature. The findings from the analysis revealed that the individual's risk over time was the overarching perspective from which to view the phenomenon. The individual's risk over time was informed by the relationships among the dimensions of the phenomenon: Individual attributes, context, conditions, processes, and consequences of the phenomenon. These findings were arranged into a novel schematic entitled *Individuals with Comorbidities Undergoing Care Transitions*. We describe in this paper the methods and findings that led to the development of the novel schematic, and recommendations for implementation of the study findings.

Design and Methods

Dimensional analysis is an inductive qualitative approach to theory generation. These approaches are gaining recognition across disciplines for their utility in eliciting detailed

explanations of complex concepts including end of life.^{15,16} Of qualitative approaches, Dimensional Analysis is most useful for examining complex social phenomena. Core assumptions of the method are that phenomena are socially constructed, situated within a specific context, and defined from an implicit perspective. Dimensionality refers to the ability of the researcher to address the inherent complexity and define the phenomenon by delineating the dimensions of the concept in terms of attributes, context, conditions, processes, and consequences.¹⁷ The *perspective* represents the vantage point from which the phenomenon occurs. *Attributes* describe the key characteristics of the individual and the *context* represents the environment in which the phenomenon occurs. The *conditions* are the dimensions that facilitate, block, or otherwise shape the processes, while the *processes* are the direct manifestations of the conditions of the phenomenon. *Consequences* represent the results from the specific actions and interactions of the *conditions* and *processes*.¹⁸

In Dimensional Analysis, constant comparison and dimensionalizing are two techniques used to ensure theoretical sensitivity and realization of all aspects of the phenomenon. Constant comparison is an iterative technique involving the review of data, consisting of words or phrases. The data are reviewed line by line in detail and assigned a code as a concept becomes apparent. As more data are reviewed, the specifications of codes are developed and refined to fit the data. Through this process, the code structure evolves inductively.^{16,19} The technique of dimensionalizing also examines the underlying concepts and theoretical relationships inherent in the code and code structure. The technique involves extracting characteristics or attributes of a code and determining possible variations or properties. This process reduces language bias in the description of the phenomenon under study.¹⁶

Sample

Dimensional Analysis can be conducted using a variety of sources of data including interviews, field notes from observations, and other written documents or literature. In the current analysis, the sample consisted of empirical literature focused on comorbidities during care transitions. The strategy for selection of the literature for the analysis was to capture a heterogeneous set of manuscripts in order to reveal the complexity and contextuality of the phenomenon under study.²⁰ The literature that ultimately served as the data sample was obtained through a systematic search process. Search strategy, data sources, screening, and selection criteria are shown in Figure 1 (See Appendix 1 for search syntax). Only studies involving comorbidities in the context of care transitions were included. A 'transition' was defined as an acute episode of chronic illness accompanied by at least one movement of a patient between health care settings.

An initial literature search generated 5,917 candidate titles. Ten percent (n=650) of the candidate titles were randomly selected to avoid introducing systematic error into the sample and obtain a manageable number of abstracts to review for the study analysis. The review yielded 60 articles for the analytical database (see Figure 1), encompassing a wide range of study designs, diseases, care transitions, and population ages (See Appendix 2 for titles of the 60 articles used for the analytical database. The authors will also provide the list of titles upon request). The 60 articles provided a heterogeneous database for analysis of the

complexity and contextuality of the phenomenon of individuals with comorbidities undergoing care transitions.²¹ Briefly, the articles were published between 1990 and 2009, and consisted of prospectively designed studies (n=19), randomized clinical trials (n=3), and retrospective studies (n=38). The ages of study participants ranged from 18 to 92 years. The majority of articles involved patients with disease diagnoses (n=48), trauma/surgical (n=7), or psychiatric (n=5). Thirty-three articles (55%) addressed higher to lower acuity transitions and 27 (45%) featured lower to higher acuity.

Data Analysis

Dimensional analysis was conducted using a three-level coding scheme (See Figure 2).²² The first level, open coding, involved extracting key words and phrases from each article. The open coding of key words and phrases intentionally disassociates the key words and phrases from their context. To conduct open coding, the 60 articles for the analysis were divided among the group of 5 researchers. In addition, each researcher conducted a cross-check to maintain scientific rigor and reliability in the open coding process. This cross-check consisted of open coding of three additional articles from another researcher's assignment. This allowed team members to compare and adjust the coding process. Each researcher's open codes were then integrated into a single document to provide a cohesive data analysis. Approximately 8,000 open codes were generated.

The second level coding, axial coding, next took place. Here, open codes were collapsed into categories and arranged into conceptually related groups.²² Concepts were refined as discretely as possible, ultimately leading to approximately 250 axial codes. The third level coding, theoretical coding, labels concepts present in one or more categories to link theoretical relationships. Theoretical coding was conducted through group discussion using constant comparison and dimensionalizing to enhance scientific rigor and analytic validity.²³ Thirty-two theoretical codes were identified. These were condensed into the most salient representations of the phenomenon and arranged into a schematic according to the five dimensions prescribed by Dimensional Analysis: perspective, context, conditions, processes, and consequences.¹⁸ Attributes of individuals with comorbidities undergoing transitions were also delineated at this time (see Table 1). The aim of the schematic was to differentiate innate characteristics of the most relevant theoretical codes, and depict their relationships to one another as they emerged in the analysis.

Reliability and Validity

Microsoft Word was used to record the terms and phrases extracted from the articles, organize the coding structure, and facilitate the analysis.¹⁸ Validity and reproducibility were enhanced with the use of an auditor external to the research team who monitored the logic of decisions, and consultation with a methodological expert. Detailed meeting minutes provided an audit trail of the project, described coding discussions, and documented analytic decisions from the inception of the project through the creation of the schematic. Additionally each team member practiced reflexivity by keeping individual memos, and added these into the group minutes. Coding structure, emerging themes, and relationships between recurrent concepts were analyzed until consensus was achieved among research team members.

Results

The findings of the analysis can be viewed in the schematic entitled *Individuals with Comorbidities Undergoing Care Transitions* (see Figure 3), which represents a complex phenomenon within an overarching perspective of *individual's risk over time*, and is organized according to the dimensions as prescribed by Dimensional Analysis methodology: *perspective, attributes, contexts, conditions and processes, and consequences*. The following sections present study findings. Italicized text is used to identify each dimension and recurrent concept that emerged as a result of the analytic process described above.

Perspective

The concept of an *individual's risk over time* is situated as the perspective for it is informed by the theoretical relationships among all dimensions depicted in the schematic. Its position at the top of the matrix represents the theoretical importance of this overarching concept regarding individuals with comorbidities undergoing care transitions. *Individual's risk over time* was characterized by phrases in the empirical articles as 'high risk', 'being at risk', 'risk adjustment', and 'risk factors'. *Time* was described discretely in terms of weeks, months, or years. Less tangible references to *time* included the timing of events and the longitudinal nature of the clinical phenomenon under study. Examples of phrases that exemplified the influence of *individual's risk over time* across all dimensions included 'risk for hospitalization' and 'time to readmission'.

Attributes

The individual's attributes are positioned at the left of the matrix, depicting their status as precursors to the process of the phenomenon. The analysis revealed five key attributes: *personal characteristics, chronic conditions and diagnoses, symptoms, history, and functional status*.

The attribute *personal characteristics* included demographic variables such as age, race, gender, and employment status. *Chronic conditions and diagnoses* represented specific disease and mental health conditions, including diabetes mellitus, congestive heart failure, end stage renal disease, and depression. Additionally, words and phrases conveyed multiplicity and chronicity of these conditions. For the attribute *symptoms*, the most prominent were those related to depression, pain, and respiratory difficulty. *History* encompassed broad references to the natural course of illness, significant medical events, and treatment history or interface with a health care system. *Functional Status* included ambulation, mobility, and social functioning that changed over time. The interaction of *personal characteristics* with the concept of *risk* conveyed a message of frailty and vulnerability among this population.

Context

As pictured in the schematic, the context consists of *hospitalization, undergoing treatments, interventions and procedures, and categorization and measurement*. In the schematic, the shading from light to dark symbolizes a subtle transition from individual representation to categorization within the health care system as the individual undergoes care transitions.

In this analysis, *hospitalization* symbolized admission to the acute care setting for a certain length of time and for a specific reason. Temporal aspects of *hospitalization* included the frequency or rate of hospitalization, references to events occurring pre-and post-hospitalization, and length of hospital stay. The risk of *hospitalization* and whether or not the *hospitalization* was planned were also prominent features in the individual undergoing care transitions.

Treatments, interventions, and procedures exemplified processes that occur during hospitalizations that influence consequences such as outcomes and costs. Terms and phrases in the empirical articles used to describe treatments included ‘patient’s work-up’, ‘interventions that facilitate earlier discharge’, and ‘introducing another medication’. *Categorization and measurement* emerged as a practice of classifying chronic conditions, illnesses, and medical problems, resulting in a label expressed in terms of comorbidities. This practice occurred while a person was hospitalized for *treatments, interventions, and procedures*. Chronic conditions, illnesses, and medical problems were classified via a variety of instruments. For example, use of ICD-9 codes, Charlson/Deyo comorbidity algorithm²⁴ and other classification strategies categorized individuals into representative groups of comorbidities.

Conditions and Processes

Comorbidities and *complications* emerged as the conditions in this analysis. The key *processes* of the clinical phenomenon representing the central actions of care delivery are *discharge* and *care management*. The interconnected relationships of *discharge* and *care management* with *comorbidities* and *complications* are depicted in the schematic via circles with arrows on both sides (see Figure 3). As *conditions* of the schematic, *comorbidities* and *complications* provide an explanatory strength that links *attributes* and *consequences* within the clinical phenomenon.

The analysis revealed *comorbidities* as complex, relational, and relative rather than static and discrete. The terms in the empirical articles used to signify these properties included associated, additional, and increasing. *Comorbidities* were characterized by their number, nature, and extent. The *number of comorbidities* conveyed that individuals typically have more than one comorbid condition. Some phrases specified the *number of comorbidities* (e.g., three) while others used more descriptive terms (e.g., multiple, additive). The *nature of comorbidities* described and differentiated individuals through disease specific labels such as psychiatric comorbidity, preoperative comorbidity, or comorbid cardiovascular disease. The *extent of comorbidities* depicted the level (e.g., high burden) or degree (e.g., substantial) of risk for some other event or experience. Terms representing *complications* were also prominent in the empirical literature, denoting infections, exacerbations, and system-specific events from both the comorbidities and the context of the care transitions including hospitalizations.

Processes are actions associated with the conditions of *complications* and *comorbidities*. The schematic depicts *discharge* and *care management* as concepts highly influenced by the *number, nature, and extent of comorbidities*. Findings from the analysis showed *discharge* as a benchmark, a status, and a dynamic process. *Discharge* also included the idea of

transferring from the hospital to another location, where some level of continued care and monitoring was necessary. *Care management* encompassed the active process of caring for the patient after discharge. Terms from the empirical articles signifying the active process of caring for patients included ‘follow-up’, ‘collaborative’, and ‘disease management’. Implicit in the *processes* of *discharge* and *care management* was the concept of transition.

Consequences

Although the term ‘consequence’ often holds a negative connotation, that is not the intention here. Rather, *consequences* are simply the culmination of the phenomenon under study, *Individuals with Comorbidities Undergoing Care Transitions*. The key consequences that emerged in this analysis were *mortality*, *readmission*, *outcomes*, *resource utilization*, *cost*, and *individual experience*.

The consequence *mortality* was prominent in the data, indicating its importance as an outcome of the clinical phenomenon, and often described in terms of time, risk, and rate. *Rehospitalization* was another important consequence that emerged in this analysis. *Rehospitalization* was often described with respect to time, risk, and rate of readmission, but infrequently associated with specific reasons (e.g., for congestive heart failure). The breadth of the concepts *mortality* and *rehospitalization* contributed to the largely nonspecific nature of the concept labeled as *outcomes*. In the empirical articles, *outcomes* were generally referred to as positive or negative or described the location or culmination of the clinical phenomenon (e.g., hospital outcomes). *Resource utilization* and *cost* were also explicit in the data and provided relevant, explanatory information regarding *consequences* of comorbidities. Terms such as ‘medical resources’, ‘costly health services’, and ‘cost of care’ exemplified *resource utilization* and *cost*. The analysis also showed the concept *individual experience* as representative of *consequences* that were personal in terms of their impact. Some examples of terms from the empirical articles describing the *individual experience* included ‘burden of comorbidity’, ‘societal engagement’, and ‘personal cost’.

Discussion

We conducted an inductive qualitative study using Dimensional Analysis approach to elucidate the underpinnings of the complex phenomenon of individuals with comorbidities undergoing transitions. The findings from the analysis showed that the individual’s risk over time represents the dominant perspective from which to view this phenomenon. This finding was based on the prevalence of the terms *risk* and *time*. We also found that *comorbidities* and *complications* and the care processes of *discharge* and *care management* provided an explanatory strength that linked *attributes* and *consequences* within the phenomenon, and informed the *individual’s risk over time*. This conclusion is depicted in the schematic entitled *Individuals with Comorbidities Undergoing Care Transitions* (see Figure 3). Previous studies support our findings, demonstrating that comorbidities are associated with risk over time and impact health care utilization, cost, and quality of life.^{13,25}

Our study adds to the body of literature in two important areas. First, the schematic depicts an interconnected relationship between *conditions* and *processes*, which impact the *consequence* of individuals with comorbidities undergoing care transitions (see Figure 3).

Hence, research focused solely on comorbidities without consideration of care processes occurring during care transitions may yield inaccurate information. The second finding from our study that adds to the literature was the identification of words and phrases that portray the experience of the individual with comorbidities undergoing transitions. The use of words such as 'diabetic' and 'Congestive Heart Failure patients' convey that individuals transitioning through the health care system undergo a classification and re-identification that is defined by their specific disease. In addition, the phrases 'burden of comorbidity', 'societal engagement', and 'personal cost' impart a personal toll on individuals' lives from comorbidities. Research is needed to elucidate the use of these phrases in measuring the individual experience during care transitions.

Providing quality health care that improves the outcomes and experience of the rising number of individuals living with comorbidities undergoing care transitions constitutes a compelling and urgent problem facing the current health care system.²⁶ The passage and implementation of the Patient Protection and Affordable Care Act (ACA)²⁷ has initiated the development of innovative programs, such as Accountable Care Organizations and the Community Based Care Transitions Program,²⁸ focused on improving health outcomes and reducing costly readmissions. The goal of these programs and research initiatives are to promote savings through quality improvement and alignment of the health care system with the values of the public it serves. The novel schematic generated by this study provides a framework to guide the design of research studies to evaluate the success of these innovative programs in achieving improvement in health outcomes and aligning with the desires and preferences of individuals with comorbidities undergoing care transitions.

We chose Dimensional Analysis, an inductive approach, because of its utility in analyzing the inherent complexity and delineating the dimensions of the phenomenon under study in terms of attributes, context, conditions, processes, and consequences. Using these dimensions, we were then able to build a novel schematic, generating a comprehensive view of individuals with comorbidities undergoing transitions. Other approaches, such as literature reviews or meta-analysis, are also useful in generating comprehensive views of complex phenomenon. However, these approaches use methods that include evaluation of the literature or integration of studies, and risk missing salient components of complex phenomenon.^{18,29,30}

The use of empirical articles for the database, rather than direct patient-level data obtained in clinical settings, may have limited the study findings. To counter this limitation, we took multiple steps and maintained scientific rigor to identify a heterogeneous database from which to examine the complexity of comorbidities in the context of care transitions. We conducted a broad literature search that generated a large group of candidate titles. We defined our literature of interest as health care transitions associated with an acute event; we excluded the search term 'transitions' to avoid narrowing the yield of articles. The selection strategy included random sampling of the candidate articles to preserve heterogeneity without introducing systematic bias. We then limited the articles for analysis to those that described care transitions associated with changes in patient acuity (e.g., hospital to home). Our decisions regarding article selection enabled us to capture literature addressing an important at-risk, high utilization population. Despite the heterogeneity of the literature, the

recurrent concepts identified by our analysis did not include family involvement or the effect of recurring transitions on individual attributes. These findings indicate important gaps in the literature and warrant further study. In addition, our definition of transitions precluded an analysis of health transitions from acute to end of life care. Future research is needed to determine the utility of our framework for understanding care transitions within settings for individuals with comorbidities.

In summary, our findings revealed that the care of individuals with comorbidities undergoing care transitions represents a complex phenomenon. The *individual's risk over time* provides an overarching perspective from which to approach the phenomenon. The relationship among *comorbidities* and *complications* and the care processes of *discharge* and *care management* affords an explanatory strength directly linking *attributes* and *consequences* within the phenomenon, which informed the *individual's risk over time*. Further research is needed to elucidate the use of the terms representing the burden of comorbidity, societal engagement, and personal cost in measuring the individual experience of comorbidities during care transitions. Implementation of the novel schematic generated from this analysis includes the design of nursing research studies to evaluate the success of innovative programs to improve health outcomes and quality of life among vulnerable populations undergoing transitions of health or health care settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Sample Selection

Figure 2.
Three-Level Coding Scheme

Schematic

Figure 3.
Dimensional Analysis Schematic

Table 1

Coding Structure

Dimensions	Recurrent Concepts	Example of Selected Terms and Phrases from Database of 60 Articles
Perspective: Vantage point from which the phenomenon occurs	Risk	High risk At-risk hospitalized elders Risk adjustments Risk factors
Time	Time	1-year mortality Within 24 hours Seven days of discharge from psychiatric hospitalization Follow up time window of six months
Attributes: Characteristics of individuals involved in the social process	Personal Characteristics	Age, race and especially gender Full-time employment
	Chronic Conditions and Diagnoses	Diabetes mellitus Congestive heart failure End-stage renal disease multiple medical problems Chronic conditions
	Symptoms	Depression symptom severity Typical chest pain for least 20 minutes Greater respiratory symptoms Severity of illness
	History	History of hospitalization History of depression History of congestive heart failure Physician's history and physical,
	Functional Status	Ambulation Coronary artery disease affects walking of amputees Influence mobility Social functioning
Context: Describes the environment in which the clinical phenomenon occurs	Hospitalization	Higher rates of hospitalization Prolonged length of hospital stay Admitted from home Factors independently associated with hospitalization
	Treatment/Procedure/Intervention	Patient's medical workup Interventions that facilitate earlier discharge Coronary artery bypass graft surgery Amputation
	Categorization/Measurement	ICD-9-CM codes Charlson scores Hospital admission database information New York Heart Association Functional Class III or IV
Conditions: Facilitate, block, or otherwise shape the processes	Comorbidities	Associated comorbidities Additional burden of comorbidity Three or more comorbidities Comorbid cardiovascular disease Implications of such comorbidity
	Complications	Hospital acquired infection Heart failure exacerbation Death from infection Diabetic with chronic complication
Processes: direct manifestations of the conditions	Discharge	First year following hospital discharge Hospital discharge status Discharged home Discharged back to the nursing home
	Care Management	Timely follow-up care Collaborative coordinated discharge planning Cost-effective disease management Breakdowns in care during the transition from hospital to home

Dimensions	Recurrent Concepts	Example of Selected Terms and Phrases from Database of 60 Articles
Consequences Culmination of the social process depicted in the dimensional analysis schematic	Mortality	Long-term mortality Mortality risk Mortality rates Subsequent mortality Increased risk of cardiovascular mortality
	Rehospitalizations	Early rehospitalization High risk for rehospitalization Rehospitalization rates Rehospitalizations caused by comorbid conditions
	Outcomes	Improved outcomes High risk of negative outcomes In-hospital outcomes
	Resource Utilization	Used more medical resources after discharge Costly health services Direct medical costs of care 5 year cardiovascular costs
Individual Experience		Individual comorbidity scores control the effects of severity of illness Considerable burden of comorbidity Unable to return to full time employment High personal and economic costs