Association of Patient-Centered Outcomes With Patient-Reported and *ICD-9*–Based Morbidity Measures

Elizabeth A. Bayliss, MD, MSPH[1,2]
Jennifer L. Ellis, MSPH[1]
Jo Ann Shoup, MA[1]
Chan Zeng, PhD[1]
Deanna B. McQuillan, MA[1]
John F. Steiner, MD, MPH[1,3]

[1]Institute for Health Research, Kaiser Permanente, Denver, Colorado

[2]Department of Family Medicine, University of Colorado Denver, Aurora, Colorado

[3]Department of Internal Medicine, University of Colorado Denver, Aurora, Colorado

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CORRESPONDING AUTHOR

Elizabeth A. Bayliss, MD, MSPH
Institute for Health Research
Kaiser Permanente
10065 East Harvard Ave, Ste 300
Denver, CO 80231-5968
elizabeth.bayliss@kp.org

ABSTRACT

PURPOSE Evaluating patient-centered care for complex patients requires morbidity measurement appropriate for use with a variety of clinical outcomes. We compared the contributions of self-reported morbidity and morbidity measured using administrative diagnosis data for both patient-reported outcomes and utilization outcomes.

METHODS Using a cohort of 961 persons aged 65 years or older with 3 or more medical conditions, we explored 9 health outcomes as a function of 4 independent variables representing different types of morbidity measures: *International Classification of Diseases, Ninth Revision (ICD-9),* a self-reported weighted count of conditions, and self-reported symptoms of depression and of anxiety. Outcomes varied from self-reported health status to utilization. Depending on the outcome measure, we used multivariate linear, negative binomial, or logistic regression, adjusting for demographic characteristics and length of enrollment to assess associations between dependent and all 4 independent variables.

RESULTS Higher morbidity measured by *ICD-9* diagnoses was independently associated with less favorable levels of 7 of the 9 clinical outcomes. Higher self-reported disease burden was significantly associated with less favorable levels of 8 of the outcomes, controlling for the 3 other morbidity measures. Morbidity measured by diagnosis code was more strongly associated with higher utilization, whereas self-reported disease burden and emotional symptoms were more strongly associated with patient-reported outcomes.

CONCLUSIONS A comprehensive assessment of morbidity requires both subjective and objective measurement of disease burden as well as an assessment of emotional symptoms. Such multidimensional morbidity measurement is particularly relevant for research or quality assessments involving the delivery of patient-centered care to complex patient populations.

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INTRODUCTION

Historically, assessment of health care quality has been quantified using disease-specific measures, such as targeted laboratory values or preventable hospitalizations.[1-4] A more stringent and patient-centered standard, however, is to assess quality with the person, rather than the disease, as the unit of analysis.[1,5-7] Doing so requires the use of patient-centered measures that express the net influence of all health conditions and their treatments on outcomes that are meaningful to patients. One example of such a measure is patient-reported outcomes that cross disease-specific boundaries (such as general health status or physical functioning).[8] Assessing quality based on outcomes that matter to patients requires additional attention to measurement processes using these outcomes.[9-12] Using patient-reported outcomes is particularly relevant when assessing process, content, and quality of health outcomes for persons with multiple interacting medical conditions, as well as for assessing multidimensional care interventions, such as implementations of the patient-centered medical home.[13,14]

The armamentarium of instruments available to quantify morbidity has expanded to meet this need and includes tools based on data from a variety of sources, including diagnosis codes, pharmacy data, chart review, and self-report.[15-20] Morbidity measured with these instruments has been associated with a variety of global outcomes that range from mortality to hospitalization to cost of care to quality of life.[16,18,20,21] Many of these morbidity scores have significant associations with more than one outcome.[20,22,23]

Ideally, the choice of instrument for a given investigation should be based on such construct validity. Even so, the choice of instrument is often based on convenience and/or available resources rather than demonstrated association with specific outcomes. For example, tools based on diagnosis codes from administrative data may be used to adjust for morbidity burden in investigations of quality-of-life outcomes or disease management behaviors—a method that may result in incomplete morbidity adjustment.[24,25] In particular, assessing self-reported morbidity burden may be underutilized because collecting self-reported data can be resource-intensive.

Self-reported morbidity assessments may incorporate biopsychosocial constructs not captured by other measures of morbidity and, therefore, may be particularly relevant for assessments using patient-reported outcomes.[20,26,27] In addition, there is evidence that any single morbidity measure may fail to capture the entire association between morbidity burden and a health outcome.[28,29] Given the complexity of most health outcomes, using 2 or more measures that draw on different primary data sources may improve the ability to explain the role(s) of morbidity in predicting a variety of such outcomes.

The goal of this investigation was to explore the independent contributions of self-reported morbidity and a morbidity measure based on administrative diagnoses for 2 types of health outcomes that are particularly relevant to persons with multiple morbidities: 6 patient-reported outcomes and 3 utilization outcomes. We hypothesized that self-reported (subjective) morbidity would be particularly important in assessing patient-reported (subjective) health outcomes, whereas morbidity measurement based on diagnosis codes would be important in assessing health care utilization.

METHODS

Study Design and Population

The data for this cross-sectional investigation were collected as baseline information for a prospective cohort study that investigates predictors of a variety of health outcomes as a function of biopsychosocial factors in a population of persons with multiple morbidities. The cohort consisted of members of Kaiser Permanente Colorado (KPCO), an integrated, not-for-profit health maintenance organization, who were aged 65 years or older, enrolled for at least 1 year, and had 3 or more of a list of 10 common chronic medical conditions. We used an invitation letter to recruit a random sample within the eligibility criteria. The response rate to the original survey was 47%—likely a result of the length of the survey. Respondents were on average 1 year younger than nonrespondents; the 2 groups did not differ with regard to diagnosis-based morbidity level or sex. Because the investigation involved surveying participants on their processes of care, we excluded members who carried a diagnosis of dementia. The investigation was approved by the KPCO Institutional Review Board.

Measures and Analytic Variables

Our goal for this study was to explore each of a set of health outcomes as a function of 4 independent variables representing different types of morbidity measures: a widely used measure based on administrative data, a self-report of a weighted count of medical conditions, self-reported symptoms of depression, and self-reported symptoms of anxiety. We chose these variables based on (1) the common use of administrative data, such as diagnoses, to quantify morbidity; (2) our hypothesis that self-reported morbidity would additionally contribute to capturing complete morbidity burden in this patient population for these outcomes; and (3) recommendations that overall morbidity assessments incorporate mental as well as physical morbidity.[30-32]

For the diagnosis-based morbidity measure, we chose the Quan adaptation of the Charlson comorbidity index, which is adapted for use with the *International Classification of Diseases, Ninth Edition (ICD-9)* diagnostic codes and has construct validity in both primary care and hospital populations for multiple outcomes, including mortality, postoperative complications, length of stay, cost of hospitalization, cost of chronic disease care, and admission to skilled nursing facilities.[15,22,23] It also has established associations with health-related quality-of-life outcomes, such as self-reported health and functional status.[33-36] We included outpatient and inpatient diagnoses for the year before survey completion. For the self-report measure, we used a measure of disease burden we previously developed and validated against health status and physical functioning. It consists of a guided, open-ended count of conditions weighted by perceived limitation resulting from each condition and produces a summary score that represents a self-report of severity-adjusted disease burden.[26,37] Depressive symptoms were assessed using the Patient Health Questionnaire 9-item depression screen (PHQ-9), and anxiety symptoms were measured using the Generalized Anxiety Disorder 7-item scale (GAD-7).[38,39] We chose values of greater than 4 on the PHQ-9 and greater than 4 on the GAD-7 as being indicative of symptoms of each condition.[40] These cut points are relatively low for these instruments and were not intended to serve as diagnostic criteria; rather, they were intended to account for emotional morbidity that could potentially confound measures of self-reported disease burden.

We chose our outcomes of interest to represent both subjective and objective health outcomes that are relevant to patients with multiple morbidities and could potentially be associated with high morbidity burden. In addition, we postulated that certain outcomes might be differentially associated with morbidity burden as calculated by administrative diagnosis data vs self-report.

We assessed 3 of the 6 patient-reported outcomes using the well-validated RAND 36 measure of health-related quality of life[41]: self-reported health status, and physical and mental well-being (physical component summary [PCS] and mental component summary [MCS] scores).[36,42] We also assessed the domains of feeling overwhelmed by one's medical conditions, experiencing financial constraints caused by health care costs, and level of general self-efficacy, concepts reported by patients to be a consequence of multimorbidity.[43] We measured these 3 concepts using an instrument we developed for the population of persons with multiple morbidities, which was previously validated against the outcomes of overall health status and physical functioning.[44] All patient-reported outcomes were normed on a 100-point scale, with a higher score representing a better outcome (eg, better health, greater self-efficacy, fewer financial constraints). We assessed both self-reported morbidity and all patient-reported outcomes via telephone survey. Utilization outcomes included inpatient, outpatient, and emergency department utilization for the period of 10 months after the original survey.

Statistical Analysis

We initially assessed bivariate correlations between the 2 morbidity measures and the outcomes of interest, followed by multivariate analyses using separate models for each outcome. For continuous outcomes (general health status, PCS score, and MCS score) we used multivariate linear regression to assess the outcome as a function of all 4 morbidity measures entered simultaneously into each model. Because of the large number of zero observations within the utilization outcomes, we dichotomized the outcomes of inpatient admissions and emergency department visits to any vs none and used logistic regression to assess these outcomes. A negative binomial model provided the best fit for the outcome of outpatient visits. The distribution of the outcomes of perceived financial constraints, feeling overwhelmed, and self-efficacy were highly skewed toward more favorable results. Because this analysis was exploratory, we opted to dichotomize at a low level of each variable (10th percentile), based on the premise that a lack of association between morbidity burden and the extreme levels of these outcome variables would preclude any further investigation of these particular outcomes. Logistic regression was also used to analyze these outcomes. All multivariate analyses were adjusted for age, sex, race, socioeconomic status, and years of enrollment.

Because the current investigation was conducted in a cohort developed for a separate study, we did not calculate sample size requirements for our outcomes. Our results present point estimates and confidence intervals for each independent association. The width of each confidence interval provides an indication of the precision of each estimate. Ranges for the independent variables vary and are listed with the results.

RESULTS

There were 961 participants in the cohort. A slight majority were female (55%), the mean age was 75 years, and they had an average of 7.9 self-reported chronic medical conditions. Two percent reported excellent health, 24% very good, 45% good, 23% fair, and 5% poor health. PCS scores were below average relative to national norms and MCS scores were approximately at the national average. Characteristics of the participant population are listed in Table 1.

There were significant bivariate correlations between both diagnosis-based and disease burden scores for all outcomes. In multivariate analyses, higher morbidity as measured by *ICD-9* diagnoses was significantly associated with less favorable levels of the outcome variables for all of the outcomes except for the MCS score and self-efficacy. In models that included the diagnosis-based morbidity score, as well as the presence of depressive and anxiety symptoms, higher self-reported disease burden was independently significantly associated with all of the outcomes except for emergency department admissions. Reported symptoms of anxiety were independently associated with the outcomes of emotional well-being, feeling overwhelmed by medical conditions, and outpatient utilization. Symptoms of depression were independently associated with all the patient-reported outcomes other

Table 1. Participant Characteristics (N = 961)

Characteristic	n	%	
Female	530	55.2	
White race	787	81.9	
Low socioeconomic status	129	13.4	
Depressive symptoms (PHQ-9 >4)[a]	342	35.6	
Anxiety symptoms (GAD-7 >4)[a]	201	20.9	
Any inpatient admission[a]	209	21.8	
Any emergency department visit[b]	222	23.1	
Death within 10 months of survey	24	2.5	
		Mean No. (SD)	**Median (5%, 95%)**
Age at survey, y	961	75.6 (5.7)	75 (68, 86)
Years enrolled before survey	961	12.4 (4.4)	14 (4, 17)
Self-reported disease count	961	7.9 (2.7)	8 (4, 12.5)
Self-reported disease burden score	960	16.8 (10.0)	15 (5, 36)
CCI year before survey	961	1.9 (1.9)	1 (0, 6)
Inclusion conditions[c]	961	3.6 (0.8)	3 (3, 5)
Outcomes			
General health score[d]	961	58.9 (21.4)	62 (20, 87)
Physical component scale[d]	958	36.4 (11.4)	36 (19, 54)
Mental component scale[d]	958	54.8 (9.0)	57 (37, 66)
Financial constraints score[d]	958	77.7 (26.2)	92 (25, 100)
Overwhelmed score[d]	959	78.5 (22.4)	83 (33, 100)
General self-efficacy score[d]	959	80.7 (16.2)	81 (50, 100)
Inpatient admissions[b] (range = 0-7)	961	0.32 (0.72)	0 (0, 2)
Emergency department visits[b] (range = 0-14)	961	0.34 (0.80)	0 (0, 2)
Office visits[b] (range = 0-62)	961	6.20 (4.97)	5 (3, 16)

CCI = Charlson comorbidity index; PHQ-9 = 9-item Patient Health Questionnaire; GAD-7 = Generalized Anxiety Disorder 7-item scale.

[a] Score of >4 indicative of symptoms of each condition.

[b] During the 10 months after the survey.

[c] From original inclusion criteria for cohort of having 3 or more of a list of 10 chronic conditions.

[d] Scored on a range from 1 to 100; higher scores indicate better outcomes (eg, better health, fewer financial constraints, greater self-efficacy).

than reported financial constraints, and with emergency department admissions (Tables 2 and 3).

In general, higher utilization of outpatient and inpatient services was more strongly associated with higher morbidity as calculated by diagnosis code than with patient-reported burden, anxiety, or depressive symptoms (Table 3). In contrast, patient-reported outcomes were strongly and more frequently associated with the subjective predictors of patient-reported disease burden and emotional symptoms (Table 2).

DISCUSSION

Increasing and improving the delivery of patient-centered care requires systematic practice change (eg, the patient-centered medical home), increased awareness by clinicians, the support of policy makers, and active engagement of patients.[45-47] Such improvements may be even more crucial for patients with multiple, complex health care needs.[48-51] In all of these cases, success is measured by achieving health outcomes that matter to patients.[52] We explored several such outcomes as a function of different measures of morbidity to determine the best methods of adjusting for morbidity in assessing these outcomes.

The independent contribution of self-reported morbidity to a selection of patient-reported and utilization outcomes suggests that a complete assessment of morbidity burden requires subjective and objective measures of morbidity, as well as assessments of mood. Overall, we found stronger associations between self-reported morbidity for patient-reported outcomes when compared with more objective outcomes of utilization. This finding suggests that assessing both self-reported morbidity and mood symptoms is particularly important in understanding the contribution of morbidity burden for investigations using patient-reported outcomes.

These results confirm previous associations of patient-reported morbidity measurement instruments with quality of life and other patient-reported outcomes.[20,27,53,54] Our investigation adds to this information by developing models that demonstrated the independent contribution of self-reported morbidity to a set of outcomes (including those that may be considered system centered as well as patient centered) while simultaneously accounting for diagnosis-based measurement of morbidity and depressive and anxiety symptoms. We observed slightly weaker independent associations between self-reported disease burden (compared with morbidity measured with diagnosis data) and the more objective outcomes of health care utilization. Previous investigations have noted varying independent contributions of self-reported functional and health status to predictions of health care costs.[55-59] Our exploratory results using a more detailed self-report of disease burden in a relatively small sample suggest that it is also important to include self-assessment of morbidity when investigating health care utilization.

We investigated 3 well-validated and frequently used patient-reported outcomes and 3 newer patient-reported outcomes that we previously developed based on interviews with persons with multiple morbidities.[43,44] The results add additional construct validation to our prior observations that the domains of financial constraints, feelings of being overwhelmed by medical conditions, and perceptions of self-efficacy are, in part, a function of morbidity burden.[26,43]

Even mild symptoms of anxiety and depression were significantly associated with selected outcomes independent of both self-reports and *ICD-9* codes of morbidity that included diagnoses of depression and/or anxiety. These associations indicate the importance of assessing symptoms of mental well-being as part of completely quantifying morbidity rather than relying on administratively-reported diagnoses of depression or anxiety.

Depending on the research question, several of

Table 2. Summary of Significant Associations Between Morbidity Measures and Patient-Reported Outcomes

	Patient-Reported Outcomes[a]					
Morbidity Measure	**General Health Status β (CI)**[b]	**Physical Well-being β (CI)**[b]	**Emotional Well-being β (CI)**[b]	**Fewer Financial Constraints Odds Ratio (CI)**[c]	**Less Overwhelmed Odds Ratio (CI)**[c]	**Self-efficacy Odds Ratio (CI)**[c]
Quan adaptation of CCI (*ICD-9*)[15] (range = 0-12)	–1.91 (–2.50 to –1.33)[d]	–0.68 (–0.99 to –0.37[d]	0.06 (–0.19 to 0.31)	0.82 (0.73 to 0.91)[d]	0.87 (0.78 to 0.96)[e]	0.96 (0.86 to 1.08)
Self-reported disease burden[26] (range = 1-89)	–0.71 (–0.84 to –0.59)[d]	–0.49 (–0.56 to –0.42)[d]	–0.11 (–0.16 to –.05)[d]	0.96 (0.94 to 0.99)[f]	0.95 (0.93 to 0.97)[d]	0.96 (0.94 to 0.99)[f]
Anxiety symptoms (GAD-7)[39] (range = 0-21)	–2.75 (–5.88 to 0.37)	1.41 (–0.24 to 3.06)	–5.90 (–7.25 to –4.56)[d]	0.64 (0.37 to 1.09)	0.57 (0.35 to 0.93)[e]	0.79 (0.48 to 1.31)
Depressive symptoms (PHQ-9)[38] (range = 0-27)	–12.01 (–14.75 to –9.27)[d]	–4.99 (–6.44 to –3.54)[d]	–5.87 (–7.05 to –4.69)[d]	0.66 (0.39 to 1.13)	0.30 (0.18 to 0.50)[d]	0.18 (0.10 to 0.33)[d]

CCI = Charlson comorbidity index; GAD-7 = Generalized Anxiety Disorder 7-item scale; *ICD- 9 = International Classification of Disease, 9th edition;* PHQ-9 = 9-item Patient Health Questionnaire.

Note: Associations expressed as point estimates with confidence intervals within separate models for each outcome.

[a] For all outcomes, higher outcome values represent a better state (eg, better physical functioning, fewer financial constraints). All models adjusted for morbidity measures above and age, sex, race, socioeconomic status, and length of enrollment.

[b] Linear regression: β estimates; nonsignificant confidence intervals cross zero.

[c] Logistic regression: odds ratios; nonsignificant confidence intervals cross 1.0.

[d] *P* value <.001.

[e] *P* value <.05.

[f] *P* value <.01.

Table 3. Summary of Significant Associations Between Morbidity Measures and Utilization Outcomes

	Utilization Outcomes[a]		
Morbidity Measure	**Outpatient Utilization Negative Binomial Regression Rate Ratio (CI)**[b]	**Inpatient Admission Logistic Regression Odds Ratio (CI)**[c]	**Emergency Department Admission Logistic Regression Odds Ratio (CI)**[c]
Quan adaptation of CCI (*ICD-9*)[15] (range = 0-12)	1.05 (1.02-1.09)[d]	1.17 (1.08-1.26)[d]	1.12 (1.04-1.22)[d]
Self-reported disease burden[26] (range = 1-89)	1.02 (1.01-1.02)[e]	1.03 (1.01-1.04)[d]	1.01 (0.99-1.03)[f]
Anxiety symptoms (GAD-7)[39] (range = 0-21)	1.23 (1.03-1.47)[f]	1.01 (0.65-1.58)	0.94 (0.62-1.43)
Depressive symptoms (PHQ-9)[38] (range = 0-27)	1.00 (0.86-1.16)	0.81 (0.55-1.20)	1.72 (1.19-2.49)[d]

CCI = Charlson comorbidity index; GAD-7 = Generalized Anxiety Disorder 7-item scale; *ICD-9 = International Classification of Diseases, Ninth Edition;* PHQ-9 = 9-item Patient Health Questionnaire.

Note: Associations expressed as rate or odds ratios with confidence intervals within separate models for each outcome.

[a] All models adjusted for other morbidity measures and age, sex, race, socioeconomic status, follow-up time, and length of enrollment.

[b] Negative binomial regression; nonsignificant confidence intervals cross 1.0.

[c] Logistic regression; nonsignificant confidence intervals cross 1.0.

[d] *P* value <.01.

[e] *P* value <.001.

[f] *P* value <.05.

our morbidity measures could also be construed as patient-reported outcomes in themselves. This raises the question of where a self-reported morbidity measure (such as disease burden or mood assessment) ends and a patient-reported outcome begins. As with all outcomes, patient-reported outcomes are context specific. For example, in assessing the effectiveness of a new model of care designed to improve the physical well-being of persons with diabetes, obesity, and heart disease, our results suggest that it would be relevant to include morbidity measurements based on diagnosis data, a measure of self-reported morbidity, and a mood assessment. Doing so would more completely account for patient morbidity and permit a more accurate assessment of the effect of the care management intervention. In contrast, in assessing the effectiveness of a new model of care designed to decrease depressive symptoms for persons with depression and obesity, it may be more appropriate to adjust for morbidity measured by diagnosis data and self-reported burden, but not depressive symptoms—as depressive symptoms would be considered an outcome of interest.

There were several limitations to this investigation. It had a cross-sectional design and, as such, could not identify causal relationships between any of the morbidity measures and the outcomes that we studied. Conclusions are based on both the characteristics of the measures (the Quan adaptation of the Charlson comorbidity index based on *ICD-9* codes) and the population (primarily white, aged 65 years and older, with health insurance). Because of skewed data, we chose low cut points for the outcomes when exploring associations between the measures of morbidity and the outcomes of financial constraints, feeling overwhelmed, and level of self-efficacy. Although we did find significant associations between the variables at these levels, these initial explorations will require more validation.

The goal of this investigation was to explore the potential contributions of specific independent variables with the selected outcomes rather than to develop complete predictive models for each outcome. We included symptoms of depression and anxiety as independent variables in our model, anticipating that there would be associations between mood symptoms and certain quality-of-life outcomes, as well as potential associations between mood symptoms and self-reported disease burden. Our findings that all of these measures have varying independent associations with patient-reported outcomes suggest it is important to include quantification of both self-reported morbidity and mood symptoms when accounting for morbidity in studies using patient-reported outcomes. Because we were not developing full predictive models, we also did not include the important domain of patient-level social factors as part of our model.[13]

In summary, our findings suggest that a complete assessment of morbidity requires both subjective and objective measurement of diseases and disease burden, as well as an assessment of emotional symptoms. Such multidimensional morbidity measurement is particularly relevant for research or quality assessments involving the delivery of patient-centered care to complex patient populations. In assessments involving these populations, overall morbidity burden may be an important independent predictor of health outcomes. Accurate measurement strategies to account for morbidity burden will become increasingly important as we develop new methods of evaluating patient-centered care delivery for complex patients.

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