



MEDICARE HEALTH OUTCOMES SURVEY

THE EVALUATION OF A MENTAL COMPONENT SUMMARY SCORE THRESHOLD FOR DEPRESSION RISK IN THE MEDICARE POPULATION

FINAL REPORT Deliverable for Task 5.20a

**PREPARED BY HEALTH SERVICES ADVISORY GROUP
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EXECUTIVE SUMMARY

Depression in elderly beneficiaries is rapidly becoming a difficult and expensive health problem. Nationally, the current prevalence rate for depression in this population is estimated to be approximately 16 percent to 20 percent (Smit et al., 2006; Keene et al., 2005). This report examines different thresholds of mental component summary (MCS) scores for identifying beneficiaries diagnosed with depression, and those at risk for depression. The confirmation of an appropriate threshold score will help the Centers for Medicare & Medicaid Services and health plans in estimating proportions of the elderly population who are undiagnosed and at risk for depression.

The results of analyses using a sample of Medicare Fee-For-Service (FFS) beneficiaries diagnosed with depression indicate a low depression prevalence rate of approximately 7 percent based on a least restrictive definition of depression. These are beneficiaries without bipolar disorder or schizophrenia who had an International Classification of Diseases-9 (2004 [ICD-9]) code of: major depressive disorder, depressive type psychosis, dysthymic disorder, chronic depressive personality disorder, prolonged depressive reaction, or depressive disorder not elsewhere classified for at least two outpatient visits, or for at least one outpatient visit and at least one inpatient admission. The mean MCS score for this group of beneficiaries is 47.6, and the mean MCS score for those not diagnosed is 54.3. Significantly more depressed beneficiaries are female and are age 80 and over. Analyses were also conducted for beneficiaries employing a more restrictive definition of depression and a strict definition of depression, based on ICD-9 codes. The prevalence rate was 4 percent and 1 percent, respectively, for these two groups. Given the low prevalence rates, a definitive conclusion about a threshold score is limited; however, results indicate that a score of 48 represents reasonable predictive accuracy across the three definitions of depression and would imply screening for 20 percent of elderly beneficiaries.

Since the prevalence rate of diagnosed depression in the FFS sample was low, the MCS threshold score was analyzed for beneficiaries in managed care with self-reported depression at baseline using *2002-2004 Cohort 5* merged data in the Medicare Health Outcomes Survey (HOS). A positive depression screen was considered to be a positive response to any of the following three depression-screening questions:

- In the past year, have you had 2 weeks or more during which you felt sad, blue or depressed; or when you lost interest or pleasure in things that you usually cared about or enjoyed?
- In the past year, have you felt depressed or sad much of the time?
- Have you ever had 2 years or more in your life when you felt depressed or sad most days, even if you felt okay sometimes?

Approximately 24 percent of the beneficiaries who positively responded to any of the above three questions have a mean MCS score of 44.9, and the mean MCS score for those who did not have a positive depression screen is 55.0. Analyses were also conducted for beneficiaries who responded positively to either of two depression-screening questions, omitting the lifetime

depression question. Approximately 20 percent of the beneficiaries positively responded to either of the first two depression-screening questions listed above. The mean MCS score for this group is 43.5, and the mean MCS score for those who do not have a positive depression screen is 54.9. The results of the HOS analyses for three depression-screening questions suggest that an optimal MCS threshold score is 49. Policy implications of this threshold score for self-reported depression would include screening approximately 30 percent of elderly beneficiaries.

Future research could target beneficiary demographic indicators such as race, education, income, and physical health as predictors of MCS deciles. Results of these analyses would be helpful in informing CMS about beneficiary subgroups that would be most likely to fall in low MCS deciles.

Optimal Cutoff MCS Scores and Percent Positive based on Fee-For-Service and Managed Care Beneficiaries				
Depression Diagnosis Standard	Optimal MCS cut-off point based on C-statistic		Optimal MCS cut-off point based on McCaffery and Elliot's Approach	
	MCS Cutoff Score	Percent Screened Positive	MCS Cutoff Score	Percent Screened Positive
<u>Depression Based on Claims*</u>				
Strict definition of depression	50	24.00%	48	19.49%
Less strictive definition of depression	51	26.72%	48	19.49%
Least strictive definition of depression	52	29.57%	48	19.49%
<u>Self-reported depression**</u>				
Two-item positive depression questions	49	28.55%	49	28.55%
Three-item positive depression questions	49	28.55%	49	28.55%

* n=271,479

** n=50,566

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INTRODUCTION

DEPRESSION AND THE ELDERLY

Recent figures indicate that clinical late-life depression has a prevalence of 16 percent to 20 percent (Smit et al., 2006; Keene et al., 2005). However, research on the FFS population using the Medicare Health Outcomes Survey (HOS) indicates that the prevalence of depression (MCS score of less than or equal to 42) is 25 percent for beneficiaries who are age 65 and older (McCall et al., 2002). Additionally, the financial costs of depression are high with older patients having approximately 50 percent higher healthcare costs than non-depressed seniors (Tian et al., 2005; HealthyPlace, 2006). Clearly, depression in the elderly is a costly health problem.

The relationship of depression to health problems and mortality has been well documented in elderly patients (Rost et al., 1998). Findings from several follow-up studies in community based cohorts of well functioning older persons have shown severe depressive symptoms at baseline to be associated with an increased risk of disability in Activities of Daily Living (ADLs) and mortality, after controlling for baseline sociodemographic factors, physical health, and cognitive functioning (e.g., Bruce et al., 1994; Pennix et al., 1999). Depression is related to declines in physical ability (Bruce et al., 1994; Kivela & Pakkala, 2001) and other diseases such as stroke (Jonas & Mussolino, 2000; Everson et al., 1998), diabetes (Anderson et al., 2001), coronary heart disease (Barefoot et al., 1996; Carney & Freedland, 2001; Freasure-Smith et al., 1995; Clouse et al., 2003) alcohol dependence (Gilman & Abraham, 2001), and higher prevalence of smoking (Anda et al., 1990). In addition, the mortality rate for depressed nursing home residents is twice that of non-depressed residents (Heston et al., 1992; Rovner et al., 1991).

The challenge for health plans and providers is to accurately diagnose depression in elderly patients, since depression presents differently in the elderly compared to the non-elderly. For example, feelings of worthlessness, psychomotor agitation, diminished ability to think or concentrate, significant weight loss, insomnia are some common symptoms of elderly depression, and for many primary care providers these symptoms are interpreted as simply a part of normal aging (Scanlon, 2006). In a study of diagnostic depression classification by general practitioners, patients were screened using a standardized psychiatric interview. These researchers found that general practitioners had difficulty differentiating depression from other psychological and social problems (Volkers et al., 2004). Comorbidity adds complexities to diagnosing depression since depression is comorbid with many chronic illnesses (Noel et al., 2004). In research on comorbidity and depression, patients with a lower educational level, less severe depression, fewer primary care contacts, and who did not have chronic somatic comorbidity were less likely to be diagnosed with depression (Nuyen et al., 2005). A recent study of patients 60 years of age and older found that those with subsyndromal depression had a 5.5-fold risk for major depression at one year after controlling for demographic characteristics (Lyness et al., 2006).

The frail elderly are particularly vulnerable to undiagnosed depression. In a recent study, homebound frail elderly were given depression measures; one of the measures was the standard psychological distress measure (PDI-29) given by a home health nurse (Preville et al., 2004). This study concludes that home health nurses are capable of a two-stage depression-screening procedure and may be an untapped source for identifying depression in the frail elderly. Short, valid screening measures for use in identifying elderly depressed beneficiaries at the individual level are available, and should be used in primary care. For example, the ten-item Center for Epidemiologic Studies Depression (Radloff, 1977 [CES-D]) scale has been shown to work best in medical settings such as clinics and hospitals; however, the fifteen-item Geriatric Depression Scale (GDS) performs best with nursing home patients (Blank et al., 2004).

In sum, the literature overwhelmingly indicates that depression in the elderly is difficult to diagnose and is associated with poor health outcomes. It is important that CMS has access to appropriate screening measures *for the elderly* to assess the prevalence of depression in the United States' Medicare population. To assist in this endeavor, this report evaluates the mental component summary (MCS) score threshold for depression risk in the elderly using the Depression Diagnosis and Diabetes Trend File from the Centers for Medicare & Medicaid Services (CMS) and Research Triangle Institute (RTI). In this file, Medicare Consumer Assessment of Healthcare Providers and Systems (CAHPS[®])¹ Fee-For-Service (FFS) data are merged with depression diagnostic data. Specifically, these data are analyzed to determine whether an MCS score of less than or equal to 42 is the optimal threshold for identifying depression risk in the Medicare age 65 and over population. An MCS score of 42 is the current standard **for the general population** according to previous research (Ware & Kosinski, 2001), in which a clinical interview was used to determine the presence or absence of depression. Identifying an appropriate MCS depression risk threshold for the Medicare population will allow CMS and health plans to estimate the prevalence of elderly depression in this population. This study examines the relationship between an International Classification of Diseases (International Classification of Diseases-9, 2004 [ICD-9]) code of depression and MCS scores, as well as self-reported depressed mood and MCS scores.

¹ CAHPS[®] is a registered trademark of the Agency for Healthcare Research and Quality.

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METHODOLOGY

DATA SOURCES

The data utilized in the study were obtained from Research Triangle Institute (RTI) and based on Medicare Fee-For-Service (FFS) beneficiaries diagnosed with depression. Data also included the Medicare Health Outcomes Survey (HOS) based on managed care beneficiaries' self-reported depression. These data files are as follows:

- *2000, 2001, and 2002 FFS Trend File with Depression and Diabetes Variables*
- *2002-2004 Cohort 5 Medicare HOS*

The following section of the Methodology describes these data sources in more detail.

CONSUMER ASSESSMENT OF HEALTHCARE PROVIDERS AND SYSTEMS

The purpose of the CAHPS surveys is to provide a standardized system for measuring and reporting health plan enrollees' experiences with the care they receive. In 1995, the Agency for Healthcare Research and Quality (AHRQ) funded the development of the original CAHPS survey by a consortium of researchers at Harvard Medical School, the Research Triangle Institute (RTI), RAND, and Westat. In 1997, CMS began collecting CAHPS survey data from managed care enrollees. In 2000, CMS initiated the Medicare FFS CAHPS survey to collect information on the experiences of enrollees in the original Medicare program. CAHPS scores are included in the Health Plan Employer Data and Information Set (HEDIS[®]) requirements for the National Committee for Quality Assurance (NCQA, 2006) accreditation of managed care plans.

The CAHPS questionnaires are administered by mail, followed by telephone interviews of beneficiaries who do not respond to the mail questionnaires. The CAHPS surveys are cross-sectional surveys; no attempt is made to resurvey beneficiaries at a later point in time. Response rates to the CAHPS questionnaires are approximately 70 percent for the Medicare FFS survey. Since 2000, results from the Medicare FFS CAHPS survey have been posted on the Medicare Web site for consumers to view (AHRQ, 2006).

The CAHPS survey data for FFS Medicare beneficiaries from 2000, 2001, and 2002 were combined and merged with 1999 through 2003 Medicare Part A and Part B claims using a beneficiary's unique identification number to form 2000, 2001, and 2002 FFS Trend File with Depression and Diabetes Variables.

MEDICARE HEALTH OUTCOMES SURVEY

Beginning in 1998 and continuing annually, an HOS baseline cohort is created from a random sample of 1,000 members per plan from MA plans in the United States. In plans with fewer than 1,000 Medicare members, the sample consists of the entire enrolled Medicare population that meets the inclusion criteria. The HOS has a longitudinal design, with each cohort having a two-year follow-up remeasurement. Medicare beneficiaries who are continuously enrolled in a given health plan for at least six months are eligible for sampling. Beneficiaries who are institutionalized, nursing home residents, or disabled under age 65 are eligible for inclusion, but those with end stage renal disease are excluded. Beneficiaries are excluded from follow up two years later if they disenrolled from their plan (voluntarily disenrolled), if their plan no longer has a contract in place at the time of follow up (involuntarily disenrolled), or for reason of death. The data collection protocol includes a combination of multiple mailings and telephone follow up over a period of approximately four months. CMS contracts with the National Committee for Quality Assurance (NCQA) to oversee the data collection activities for the Health Plan Employer Data and Information Set (HEDIS[®])², which includes the Medicare HOS.

The HOS survey measures physical and mental health status and includes demographic and other background information such as gender, age, race, marital status, education, annual household income, homeowner status, and Medicaid enrollment, smoking status, the presence or absence of selected chronic conditions, and other negative health symptoms. The complete data collection protocol can be found in the *HEDIS[®] Volume 6: Specifications for the Medicare Health Outcomes Survey* (NCQA, 2002, 2004).

12-ITEM HEALTH SURVEY

The MCS scores used in the current analyses for determining a depression risk threshold were derived from a 12-item health survey, which is included in the Medicare FFS CAHPS survey. The survey is a shorter, valid version of the larger 36-item health survey, which is a key component of the Medicare HOS. Similar to the 36-item survey, the 12-item survey measures the following eight concepts: physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health. The mental component correlates highly with the mental health, role emotional, and social functioning scales. These sub-scales also contribute most to the mental component summary score.

Based on data from a general population, the MCS mean score is 50.04 with a standard deviation of 9.59, which is the same as the 36-item population mean, and almost the same as the 36-item standard deviation (10.00). MCS norms based on the 12-item health survey are available for age, sex, specific comorbidities, severity levels of specific chronic conditions, negative physical symptoms, and are available for patients with and without comorbidities. MCS score

² HEDIS[®] is a registered trademark of the National Committee for Quality Assurance.

comparisons between the 36-item and 12-item surveys are available for longitudinal mental health transitions, patients with clinical depression and minor medical conditions, and for patients after recovery from clinical depression. In sum, empirical evidence indicates that the MCS score from the 12-item health survey is a reliable and valid indicator of mental functioning in the general population (Ware, Kosinski & Keller, 1995).

ANALYTIC STRATEGY

SIGNAL DETECTION THEORY

Signal Detection Theory (SDT) was used to assess the effectiveness of various MCS cutoff scores. The roots of SDT trace back to Gauss and Fechner (Link, 1994). SDT has been applied to clinical assessments and diagnostic test decision-making, and has also been applied to those at risk for disease or poor health outcomes (Kiernan et al., 1998). The conceptual framework underpinning SDT involves discriminating between mutually exclusive states. Examples include a hearing test in which a subject either hears a tone, or does not; and a patient who is suffering from panic disorder or not. The “signal” is the stimulus or psychological illness. Any high performing diagnostic system must address the accuracy of its application; the hearing test or panic disorder diagnosis must decrease the probability of false positives and false negatives and increase true positives and true negatives (McFall and Treat, 1999). McFall and Treat note that SDT provides a significant improvement over traditional methods of assessing the accuracy of diagnostic systems because SDT estimates accuracy from the receiver operating characteristic (ROC) curve. The ROC curve plots the sensitivity against 1-specificity at possible score cutoff values. SDT’s conceptual framework can be applied to determining an optimal MCS cutoff score, as detailed later in this section of this report.

DIAGNOSIS OF DEPRESSION

RTI consulted with Dr. Alisa Busch, a psychiatrist from McClean Hospital in Massachusetts who has experience using administrative data, to help identify ICD-9 diagnostic codes for depression.³ Various coding systems are available for capturing diagnostic information, and each has its own strengths and weaknesses. In their comprehensive review, O’Malley et al. (2005) note that ICD-9 code accuracy includes both random and systematic errors. One systematic source of error occurs in the quality and quantity of communication between the patient and the admitting clerk. Another systematic error involves the coders. Generally, clinicians do not assign the ICD-9 code; coders assign them based on clinical information in the patient’s chart.

³ Information contained in a letter, accompanying the Year 1, 2, 3 FFS Trend File with Depression Analyses Variables data file sent to HSAG. The letter was addressed to Edward Sekscenski, CMS Project Officer, from Jeff Laufenberg, RTI International, dated February 23, 2005.

Understanding the coding process is important to understanding the ICD-9 codes. Figure 1 lists ICD-9 codes for various depression diagnoses.

Figure 1 Identification of ICD-9 Codes	
Code Number	Diagnosis
296.2	Major depressive disorder, single episode
296.3	Major depressive disorder, recurrent episode
298.0	Depressive type psychosis
300.4	Dysthymic disorder
301.12	Chronic depressive personality disorder
309.1	Prolonged depressive reaction
311	Depressive disorder, not elsewhere classified

The ICD-9 codes and definitions used in the current study are listed below as **Strict Definition**, **Less Restrictive Definition**, and the **Least Restrictive Definition**. Beneficiaries could be diagnosed with depression 12 months prior to the survey or 12 months following the survey. Each ICD-9 diagnosis code is identified as either “pre,” which is a diagnosis 12 months prior to the survey, or “post,” which is a diagnosis in the 12 months following the survey. These definitions are identified below.

Strict Definition of Depression

Persons without bipolar disorder or schizophrenia who meet one of the following criteria: 296.2 or 296.3 as the primary diagnosis for an inpatient admission; OR 296.2 or 296.3 as any diagnosis for at least 2 outpatient visits; OR 296.2 or 296.3 for any diagnosis for at least 1 outpatient visit and at least 1 inpatient admission.

Less Restrictive Definition of Depression

Persons without bipolar disorder or schizophrenia who meet one of the following criteria: 296.2, 296.3, 298, 311, 300.4, 301.12, or 309.1 as the primary diagnosis for an inpatient admission; OR an occurrence of 296.2, 296.3, 298, 311, 300.4, 301.12, or 309.1 as any diagnosis for at least 2 outpatient visits; OR an occurrence of 296.2, 296.3, 298, 311, 300.4, 301.12, or 309.1 for any diagnosis for at least 1 outpatient visit and at least 1 inpatient admission.

Least Restrictive Definition of Depression

Persons without bipolar disorder or schizophrenia who meet the following criteria: 296.2, 296.3, 298, 311, 300.4, 301.12, OR 309.1 as either a primary or a secondary diagnosis.

DEMOGRAPHIC COMPARISONS

Our first step was to examine demographic differences between beneficiaries who were diagnosed with depression and those who were not, based on the least restrictive definition of depression. We used effect sizes for proportions and means as a measure of significance, because traditional statistical measures produce numerous significant p values when large samples are compared, as is the case here. The question becomes, which of these statistically significant differences is large enough to be used in making policy decisions? Effect size is “A measure of the magnitude of a relationship, either in the units of the original measure...or in standardized units” (Cohen et al., 2003, p. 673). The most common standard for deciding which effect sizes are meaningful are Cohen’s (1988) definitions of small, medium and large effect sizes, which we have adopted here. A small effect size is defined as greater than, or equal to, 0.20, but less than 0.50. A medium effect size is greater than, or equal to, 0.50, but less than 0.80, and a large effect size is greater than, or equal to, 0.80.

Cohen’s effect size for the difference between two proportions p_1 and p_2 was calculated as:

$$h = |\varphi_1 - \varphi_2|$$

$$\text{where: } \varphi_1 = 2\arcsin(\sqrt{p_1}) \text{ and } \varphi_2 = 2\arcsin(\sqrt{p_2})$$

The effect size for the difference between two means x_1 and x_2 was calculated with Hedges’ g , (Rosenthal & Rosnow, 1991) using the pooled standard deviation:

$$g = \frac{x_1 - x_2}{s_{pooled}}$$

EVALUATION OF CUTOFF SCORES

The second step in the analytic strategy was to assess the number of beneficiaries who had a diagnosis of depression and who also had a specific MCS cutoff score (true positives), for each definition of depression (strict, less restrictive, and least restrictive). Beneficiaries may be diagnosed with depression but have an MCS score that is above the cutoff score (false negatives). Beneficiaries may also have an MCS score that is less than the cutoff, but do not have a diagnosis of depression (false positives). Alternatively, beneficiaries may not have a diagnosis of depression and also may have a MCS score that is above the cutoff score (true negatives). Figure 2 summarizes the possibilities described above, as well as several measures that can be used to assess the performance of the cutoff score: sensitivity, specificity, accuracy, and positive and negative predictive values (Friis & Sellers, 1999).

Figure 2
Classification of Possible Results for an MCS Cutoff Score and Depression

		Diagnosed with Depression	Not Diagnosed with Depression		
Cutoff Score	Positive	a = True positives	b = False positives	Total a + b	Predictive Value (+) a / a + b
	Negative	c = False negatives	d = True negatives	c + d	Predictive Value (-) d / c + d
	Total	a + c	b + d		
		Sensitivity a / a + c	Specificity d / b + d	Grand Total a + b + c + d	Accuracy (a + d)/(Grand Total)

Sensitivity refers to the ability of the MCS cutoff score to correctly identify beneficiaries with depression who actually have depression. Specificity refers to the ability of the MCS cutoff score to correctly identify the enrollees as not having depression who actually do not have depression. As sensitivity increases, the number of beneficiaries with depression who will be missed from being identified as having depression (false negative) will decrease. However, a number of beneficiaries without depression who will be identified as having depression will also increase. Alternatively, as specificity increases, the number of beneficiaries without depression who will be identified as having depression (false positive) will decrease. This will also decrease the number of enrollees who will be identified as having depression who actually have depression. An optimal cutoff score achieves high percentages for sensitivity and specificity. According to Myrowitz, “The key to successful screening is to balance the referral criteria so that both the overreferrals and underreferrals are minimized” (1984, p. 360).

Another criterion in assessing an optimal cutoff score is to examine the area under a ROC curve. The ROC curve provides the *c* statistic, which is the area under the curve that compares true positives (on the *y* axis, sensitivity) to false positives (on the *x* axis, 1-specificity). If the area under the curve is 0.5, then the test provides 50 percent sensitivity and 50 percent specificity, which indicates that the cutoff score performs no better than chance. Perfect performance of the cutoff score produces a *c* statistic of 1.00. Although there is not a single value that indicates best performance, the literature generally points to *c* statistics of at least 0.70 as indicative of good performance (e.g. Burd et al., 2006; Weiner, 2003; Wiviott et al., 2004), and “the higher, the better” (National Institute of Health, 2006). The goal of a ROC curve is to provide an optimal “trade off” between the costs of failing to detect true positives against the costs of false positives. Logistic regression was used to model the probability of having a depression diagnosis, given the specified MCS score. The *c*-statistic associated with the logistic regression model was used to assess model discrimination and is equivalent to the area under the ROC curve. Additionally, 2x2 classification tables by depression diagnosis and specified MCS cutoff scores were developed and used to calculate sensitivity, specificity, positive and negative predictive values, and accuracy associated with specified MCS cutoff scores (see Figure 2). We examined MCS cutoff

scores of 23 through 56 for each of the definitions of depression, and compared our results to the results reported in the SF-36^{®4} *Summary Measures Manual* (Ware & Kosinski, 2001).

For a comparison to the HOS population and self-reported depression, we utilized the ROC curve and associated *c* statistics for the 2002-2004 Cohort 5 merged file, to calculate MCS scores based on the 12-item health survey subset extracted from the SF-36[®] Health Survey (norm-based scoring algorithm). For one set of analyses, depression was defined in the same manner as for the Medicare HOS; a positive response to any of the following three depression-screening questions reflected a positive depression screen.

- ❑ In the past year, have you had 2 weeks or more during which you felt sad, blue or depressed; or when you lost interest or pleasure in things that you usually cared about or enjoyed?
- ❑ In the past year, have you felt depressed or sad much of the time?
- ❑ Have you ever had 2 years or more in your life when you felt depressed or sad most days, even if you felt okay sometimes?

Because one of the depression-screening questions asks about lifetime depression, we also examined a positive depression screen as a positive response to either two of the three depression-screening questions (the lifetime depression question was omitted). It is important to note that the depression-screening questions in the HOS do not constitute a clinical diagnosis of depression. A positive response to two or three of the depression-screening questions captures beneficiaries who are at *an increased risk* or who have a “depressed mood” and does not constitute a diagnosis for clinical depression. We analyzed MCS cutoff scores of 23 through 56, calculated sensitivity, specificity, accuracy, and positive and negative predicted values, and again compared our results to the Ware and Kosinski (2001) results.

⁴ SF-36[®] is a registered trademark of QualityMetric, Inc.

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RESULTS

DEMOGRAPHICS

There are 18,524 beneficiaries (6.8 percent) in the combined years of 2000, 2001, and 2002 data with diagnosed depression, based on the least restrictive definition of depression; 252,955 beneficiaries did not have a diagnosis of depression (CMS/RTI Year 1, 2, 3 FFS Trend File with Depression and Diabetes Analysis Variables, see Table 1). Small effect sizes were found between depressed and non-depressed beneficiaries for gender. Approximately 67 percent of the depressed group are females, whereas approximately 56 percent of the non-depressed group are females ($h = 0.211$). Beneficiaries age 80 and older comprise about 35 percent of those diagnosed with depression, but only 24 percent of those not diagnosed with depression ($h = 0.238$). Significance was not found for any other age group. No significant differences between beneficiaries diagnosed with depression and those not diagnosed were found for race or education. However, significantly more depressed beneficiaries have proxy respondents (approximately 32 percent), compared to those who are not depressed (16 percent; $h = 0.390$). Approximately 13 percent of the depressed beneficiaries receive Medicaid, compared to those who are not depressed (7 percent; the effect size approached significance at $h = 0.195$). A medium effect size was found for the physical component summary (PCS) score. The mean PCS score for depressed beneficiaries is 34.5 (SD = 12.20) and for non-depressed beneficiaries, the mean PCS score is 40.9 (SD = 12.66; $g = 0.507$). The mean MCS score approached a large effect size ($g = 0.776$). Depressed beneficiaries have a mean MCS score of 47.6 (SD = 11.03) and non-depressed beneficiaries have a mean MCS score of 54.3 (SD = 8.37).

Table 2 presents the prevalence of ICD-9 diagnoses for mental health and the mean MCS scores for respondents with specific diagnoses, as well as the overall prevalence of beneficiaries diagnosed with depression using each of the three definitions of depression. As mentioned above, 6.8 percent of the FFS sample is diagnosed with depression based on the least restrictive definition of depression. Approximately 4 percent of the sample is diagnosed with depression based on the less restrictive definition of depression, and 1.3 percent is diagnosed with depression based on the strict definition of depression. The largest majority of the sample is diagnosed with depressive disorder (12,255, 4.5 percent), 1.5 percent (4,056) is diagnosed with other nonorganic psychoses, and 1.4% (3,772) is diagnosed with major depressive disorder. Approximately 1 percent (3,102) of the sample is diagnosed with neurotic depression, 0.4 percent (1,077) with bipolar disorder, 0.2 percent (635) with schizophrenia, 0.1 percent (133) with prolonged depression reaction, and nine beneficiaries are diagnosed with chronic depressive personality disorder. Respondents with ICD-9 mental health diagnoses had lower mean MCS scores when compared to respondents without the diagnoses.

CLASSIFICATION TABLE AND ROC RESULTS: DIAGNOSED DEPRESSION

LEAST RESTRICTIVE DEFINITION OF DIAGNOSED DEPRESSION

Table 3 presents the *c*-statistics, sensitivity, specificity, accuracy, positive predictive values, negative predictive values, true positives, false positives, false negatives, true negatives, and the percent positive associated with using various levels of MCS cutoff scores to identify enrollees with depression. Enrollees were defined as having depression based on diagnosis codes derived from claims data. Logistic regression was used to model the relationship between having a depression diagnosis and MCS scores. The *c*-statistics derived from the model were relatively low indicating low discriminatory power, and ranged from 0.512 to 0.656. The *c*-statistic increased as MCS cutoff scores increased and remained relatively stable as MCS scores reached 52 (Figure 3). A 2x2 table classifying enrollees based on the presence or absence of a depression diagnosis, and whether their MCS scores were below or above the cutoff point was used to calculate sensitivity, specificity, accuracy, positive predictive values, and negative predictive values. As MCS cutoff scores increased, sensitivity increased and specificity decreased. The positive predictive value was relatively low and the negative predictive value was relatively high across all MCS cutoff scores because the predictive values were affected by the low prevalence of depression diagnoses (Friis & Sellers, 1999). Based on claims data, only 6.8 percent of the enrollees were diagnosed with depression.

As stated earlier, one criterion for assessing an optimal cutoff score is the area under the ROC curve, or the *c* statistic. Another criterion is the balance between sensitivity and specificity. We use these two criteria to determine an optimal MCS threshold score. According to Table 3, the scores of 52 and 53 provide the largest area under the ROC curve (0.656), compared to all other scores. However, the best balance between sensitivity and specificity is for a score of 54 (sensitivity = 0.657, specificity = 0.649). Figure 3 plots the *c*-statistic, sensitivity, specificity, and accuracy for MCS scores from 23 to 56. These statistics converge at an MCS cutoff score of 54.

To further understand the relationship between MCS scores and the presence or absence of depression diagnosis, we sorted the enrollees' MCS scores from low to high and created ten groups of 10 percent each (deciles). Table 4 shows the mean and the range of MCS scores, as well as the percentage of enrollees with a depression diagnosis within each decile. As expected, the lower the MCS score, the higher the probability of enrollees having a depression diagnosis. The lowest decile of MCS scores (decile one) contains the highest percentage of depressed beneficiaries (18.5 percent) with the lowest mean score and the largest range of scores (mean score = 33.7; minimum score = 7.7; maximum score = 40.5). The second highest percentage of depressed beneficiaries is in decile two (12.59 percent) with a mean score of 44.9 (minimum score = 40.5, maximum score = 48.2). Deciles one and two contain 31.1 percent of beneficiaries diagnosed with depression. The percentages of depressed beneficiaries in the other deciles range from 9.3 percent (decile three) to 2.8 percent (decile seven). In decile ten the percentage of beneficiaries diagnosed with depression is 3.9 percent. Pooling adjacent deciles where the depression proportion does not decrease monotonically suggests a set of six ordered bins: for MCS scores of less than 40.5 (18.5 percent depression), MCS 40.5 - 48.2 (12.6 percent

depression), MCS 48.2 - 52.2 (9.3 percent depression), MCS 52.2 - 54.7 (6.3 percent depression), MCS 54.7 - 57.8 (4.5 percent depression), MCS greater than 57.8 (3.2 percent depression).

According to McCaffery and Elliott (2006, manuscript under review), when the goal is to use predicted depression as a predictor of the relationship between true depression (or true diagnosed depression) with outcomes such as CAHPS scores or utilization (in situations where diagnosis is not available), one need not first classify beneficiaries into binary groups (“likely depressed” versus “unlikely”). Instead, the predicted probability of a depression diagnosis associated with various MCS cutoff scores can be incorporated directly into a simple or multivariate regression model, and the coefficient can be interpreted as if it came from a dummy coding depression diagnosis (e.g. it estimates the difference associated with depressed versus not depressed). If we use predicted probabilities corresponding to the six ordered bins described above, this approach retains 10 percent of the efficiency of analyses of outcomes that employ known depression diagnosis (not predicted from MCS), meaning that for a given level of statistical power, sample sizes would need to be an order of magnitude larger with proxy diagnosis than with actual diagnosis. McCaffery and Elliott show that this approach is more efficient than any two-category classification method and is nearly as efficient as considerably more complex Bayesian methods. For predicting outcomes, the most efficient two-category classification based on deciles would be the first and second deciles (MCS < 48.2, 15.5 percent diagnosed depressed), versus the third through the tenth deciles (MCS > 48.2, 4.7 percent diagnosed depressed), which corresponds to the cutoff score of less than 48.24 versus greater than 48.24.

LESS RESTRICTIVE DEFINITION OF DIAGNOSED DEPRESSION

Based on a less restrictive definition of depression, there are 10,923 (4 percent) beneficiaries diagnosed with depression. Table 5 presents the *c*-statistics, sensitivity, specificity, accuracy, positive predictive values, negative predictive values, true positives, false positives, false negatives, true negatives, and the percent positive associated with using various levels of MCS cutoff scores to identify enrollees with depression, based on a less restrictive definition of depression. *C*-statistics are again low and range from 0.514 to 0.640, indicating low discriminatory power. The *c*-statistic increased as MCS cutoff scores increased and remained relatively stable as MCS scores reached 51 (Figure 4). A 2x2 table classifying enrollees based on the presence or absence of a depression diagnosis, and whether their MCS scores were below or above the cutoff point was used to calculate sensitivity, specificity, accuracy, positive predictive values, and negative predictive values. As MCS cutoff scores increased, sensitivity increased and specificity decreased. The positive predictive value was relatively low and the negative predictive value was relatively high across all MCS cutoff scores because the predictive values were affected by the low prevalence of depression diagnoses (Table 5).

Table 6 presents the mean and the range of MCS scores, as well as the percentage of enrollees with a less restrictive depression definition within each decile. As expected, the lower the MCS score, the higher the probability of enrollees having a depression diagnosis. The lowest decile of MCS scores (decile one) contains the highest percentage of depressed beneficiaries (11.5

percent) with the lowest mean score and the largest range of scores (mean score = 33.7; minimum score = 7.7; maximum score = 40.5). The second highest percentage of depressed beneficiaries is in decile two (7.5 percent) with a mean score of 44.9 (minimum score = 40.5, maximum score = 48.2). Deciles one and two contain 18.9 percent of beneficiaries diagnosed with depression.

The percentages of depressed beneficiaries in the other deciles range from 5.6 percent (decile three) to 1.5 percent (decile seven). In decile ten the percentage of beneficiaries diagnosed with depression is 2.2 percent. Pooling adjacent deciles where the depression proportion does not decrease monotonically suggests a set of six ordered bins for MCS scores of less than 40.5 (11.5 percent depression), MCS 40.5 - 48.2 (7.5 percent depression), MCS 48.2 - 52.2 (5.6 percent depression), MCS 52.2 - 54.7 (3.5 percent depression), MCS 54.7 - 57.8 (2.6 percent depression), MCS greater than 57.8 (1.8 percent depression). For predicting outcomes, the most efficient two-category classification based on deciles would be the first and second deciles (MCS < 48.2, 9.5 percent diagnosed depressed), versus the third through the tenth deciles (MCS > 48.2, 2.7 percent diagnosed depressed), which corresponds to the cutoff score of less than 48.24 versus greater than 48.24.

STRICT DEFINITION OF DIAGNOSED DEPRESSION

Based on a strict definition of depression, there are only 3,467 (1.3 percent) beneficiaries with diagnosed depression. Table 7 presents the *c*-statistics, sensitivity, specificity, accuracy, positive predictive values, negative predictive values, true positives, false positives, false negatives, true negatives, and the percent positive associated with using various levels of MCS cutoff scores to identify enrollees with depression, based on a strict definition of depression. *C*-statistics are low and range from 0.520 to 0.659, again indicating low discriminatory power. The *c*-statistic increased as MCS cutoff scores increased and remained relatively stable as MCS scores reached 50 (Figure 5). A 2x2 table classifying enrollees based on the presence or absence of a depression diagnosis, and whether their MCS scores were below or above the cutoff point was used to calculate sensitivity, specificity, accuracy, positive predictive values, and negative predictive values. As MCS cutoff scores increased, sensitivity increased and specificity decreased. The positive predictive value was relatively low and the negative predictive value was relatively high across all MCS cutoff scores because the predictive values were affected by the extremely low prevalence of depression diagnoses (Table 7).

Table 8 presents the mean and the range of MCS scores, as well as the percentage of enrollees with a strict definition of depression within each decile. As expected, the lower the MCS score, the higher the probability of enrollees having a depression diagnosis; however, the percentages in each decile do not exhibit the variance evident in analyses based on the least restrictive definition of depression, due to the very low prevalence of diagnosed beneficiaries using the strict definition. The lowest decile of MCS scores (decile one) contains the highest percentage of depressed beneficiaries (4.4 percent) with the lowest mean score and the largest range of scores (mean score = 33.7; minimum score = 7.7; maximum score = 40.5). The second highest percentage of depressed beneficiaries is in decile two (2.4 percent) with a mean score of 44.9

(minimum score = 40.5, maximum score = 48.2). Deciles one and two contain 6.8 percent of beneficiaries diagnosed with depression.

The percentages of depressed beneficiaries in the other deciles range from 1.7 percent (decile three) to 0.43 percent (decile seven). In decile ten the percentage of beneficiaries diagnosed with depression is 0.52 percent. Pooling adjacent deciles where the depression proportion does not decrease monotonically suggests a set of six ordered bins for MCS scores of less than 40.5 (4.4 percent depression), MCS 40.5 - 48.2 (2.4 percent depression), MCS 48.2 - 52.2 (1.7 percent depression), MCS 52.2 - 56.3 (0.9 percent depression), MCS 56.3 - 57.8 (0.6 percent depression), MCS greater than 57.8 (0.5 percent depression). For predicting outcomes, a two-category classification based on deciles would be the first and second deciles (MCS < 48.2, 3.4 percent diagnosed depressed), versus the third through the tenth deciles (MCS > 48.2, 0.75 percent diagnosed depressed), which corresponds to the cutoff score of less than 48.24 versus greater than 48.24.

CLASSIFICATION TABLE AND ROC RESULTS: DEPRESSION-SCREENING QUESTIONS

Due to the low rate of diagnosed depression in the FFS sample, we analyzed self-reported depression in the Medicare HOS 2002-2004 Cohort 5. Table 9 presents the classification and ROC results for three depression-screening questions using the HOS sample. Using self-reported depression, the depression prevalence rate for three depression-screening questions is 24.1 percent (12,160). An MCS cutoff score of 52 provides the best balance for sensitivity (0.725) and specificity (0.740). The corresponding *c*-statistic is 0.732, which is the second highest *c*-statistic for all scores. Figure 6 plots the accuracy, sensitivity, specificity, and *c*-statistics for MCS cutoff scores from 23 to 56, and indicates that these statistics converge close to a score of 52.

Table 10 classifies the presence of self-reported depression based on the three depression-screening questions by MCS decile. Based on McCaffery and Elliott's approach discussed earlier, we smoothed across bins where the pattern is not monotonic and arrived at the prediction bins of the first, second, third, fourth, fifth, sixth, and seventh to the tenth deciles. This results in a 7-bin predicted probability of having self-reported depression of 72.8 percent, 47.6 percent, 36.4 percent, 23.6 percent, 17.8 percent, 13.1 percent, and 7.3 percent for MCS scores of less than 38.6, 38.6 - 45.0, 45.0 - 49.6, 49.6 - 52.9, 52.9 - 55.4, 55.4 - 57.2, and greater than 57.2, respectively. To determine a two-category classification, the most efficient decile cutoff would be based on the first to the third decile versus the fourth to tenth decile, which corresponds to the cutoff score of less than 49.6 versus greater than 49.6. The predicted probabilities of having self-reported depression associated with this cutoff point are 52.3 percent and 11.9 percent, respectively.

We examined results for two depression-screening questions, omitting the lifetime depression question. The prevalence rate for two depression-screening questions is 20 percent (10,132). Table 11 presents MCS cutoff scores of 23 through 56 for two depression-screening questions.

The best balance between sensitivity (0.755) and specificity (0.762) is for an MCS cutoff score of 51. The corresponding *c*-statistic is high at 0.759. Figure 7 plots the convergence of accuracy, sensitivity, specificity, and the *c*-statistics. According to this graphic, an MCS score of 51 best represents the convergence.

Table 12 presents the results of the decile analysis for two depression-screening questions. Decile one contains 69.4 percent of beneficiaries with self-reported depression. The mean MCS score for this decile is 33.7 (minimum MCS score = 9.0, maximum MCS score = 38.6). Decile two has 41.97 percent of depressed beneficiaries with a mean MCS score of 42.0 (minimum MCS score = 38.6, maximum MCS score = 45.0). Other deciles range from 31.10 percent in decile three to 4.57 percent in decile seven.

Based on McCaffery and Elliott's approach (2006), we smoothed across bins where the pattern is not monotonic and arrived at the prediction bins of the first, second, third, fourth, fifth, sixth, and seventh to the tenth deciles. This results in a 7-bin predicted probability of having self-reported depression of 69.4 percent, 42.0 percent, 31.1 percent, 18.9 percent, 13.1 percent, 8.7 percent, and 4.2 percent for MCS scores of less than 38.6, 38.6 - 45.0, 45.0 - 49.6, 49.6 - 52.9, 52.9 - 55.4, 55.4 - 57.2, and greater than 57.2, respectively. To determine a two-category classification, the most efficient decile cutoff would be based on the first to the third decile versus the fourth to tenth decile, which corresponds to the cutoff score of less than 49.6 versus greater than 49.6. The predicted probabilities of having self-reported depression associated with this cutoff point are 47.5 percent and 8.2 percent, respectively.

Table 13 is a summary table of the overall results found for optimal MCS cutoff scores based on the *c* statistic and on McCaffery and Elliot's approach (2006). Overall, the *c* statistics indicate cutoff MCS scores of 50-52 for diagnosed depression and a cutoff MCS score of 48 based on McCaffery and Elliot's approach. The results for self-reported depression in the HOS sample for both the *c* statistics and McCaffery and Elliot's approach indicate an MCS cutoff score of 49.

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DISCUSSION

The costs of depression, both quality of life-related and economic, are great. According to the Committee on Aging of the Group for the Advancement of Psychiatry, there is a looming mental health crisis for elderly people (2005). These authors state, “Mental health coverage under the Medicare+Choice [*sic*] models presents serious concerns unless significant reform efforts are undertaken” (p. 795). In a recent study of depressed elderly patients in a primary care setting, those who had minor or subsyndromal depression had a five-fold risk of major depression after one year, controlling for demographic characteristics. Medical burden, self-rated physical health, and perceived social support were significant predictors of depression outcome (Lyness et al., 2006). Untreated depression has negative consequences; however, evidence suggests that quality improvement programs for depression are effective (Wells et al., 2005). Clearly, it is important that health plans conduct depression screening for Medicare beneficiaries.

In the current study, beneficiaries 80 years of age and over were significantly more likely to be diagnosed with depression. Recent research confirms this finding. Using the Geriatric Depression Scale, depression was found to be “frequent and persistent” in persons over 85 (Stek et al., 2006). Additionally, the finding in the current study that females were more likely to be diagnosed with depression compared to males, supports other research (e.g. National Institute of Mental Health, 2006).

DIAGNOSED DEPRESSION

The goal of the current study was to evaluate the MCS score threshold for the identification of depression risk in Medicare beneficiaries. However, based on the analyses in the current study, it may be premature to finalize an optimal MCS threshold score for diagnosed depression. The low prevalence of diagnosed depression for each individual definition of depression is a primary reason that a single optimal cutoff score may not yet be attainable. Since the prevalence of late-life depression is between 16 percent and 25 percent, and the fact that older Americans are more likely to die by suicide (National Institute of Mental Health, 2003), the low rate found in the FFS sample indicates that depression is most likely seriously underdiagnosed in these Medicare beneficiaries.

Possible reasons for the low rate of diagnosed depression include provider difficulty in diagnosing elderly depression, as well as comorbidities. Additionally, the results for areas under the ROC curve (*c*-statistic) for all FFS MCS cutoff scores are below 0.70. Though a score of 54 provides the best balance between sensitivity and specificity and has a *c*-statistic of 0.653, this score would be prohibitive as a threshold score due to the cost of screening so many beneficiaries based on the least restrictive definition of depression (37.19 percent). The decile analysis points to an MCS cutoff score of 48. This score has similar statistical properties (*c*-statistic of 0.635) to a score of 54, and corresponds to approximately 20 percent screened positive. Interestingly, the

decile analysis indicated the MCS cutoff score of 48 across the strict, less restrictive, and least restrictive definitions of depression. CMS and plans should find it useful in estimating that 20 percent of the elderly beneficiary population falls below an MCS cutoff score of 48.

Using a general population sample, Ware and Kosinski (2001) provide statistical information for scores of 23, 32, 37, 42, and 52. According to their results, for a score of 42, the largest area under the ROC curve is 0.77, the sensitivity for a score of 42 is 73.7 percent, and specificity is 80.6 percent; accuracy is not reported. In the current study, a cutoff score of 42 produced a *c* statistic of 0.600, a sensitivity of 30.03 percent, and a specificity of 89.93 percent.

There are two important reasons for the differences between the optimal MCS score of 42 found by Ware and Kosinski (2001), and the optimal MCS cutoff scores found in the current study. First, a smaller sample size ($n = 503$) was used in the Ware and Kosinski ROC analyses. Second, major depression and/or dysthymia were diagnosed with the National Institute of Mental Health Diagnostic Interview Schedule (Ware & Kosinski, 2001). Interestingly, though Ware and Kosinski (2001) used a clinical interview, their *c* statistics were only somewhat higher than the statistics reported here. Additionally, Ware and Kosinski report a higher depression prevalence rate (14.6 percent) in their sample. Larger sample sizes and lower depression prevalence in the current analyses, in addition to different diagnostic criteria, all may affect the differences in optimal MCS cutoff scores found in each study. Finally, Ware and Kosinski determined an MCS cutoff score using a general population, not an elderly population.

SELF-REPORTED DEPRESSION

Due to the underdiagnosis of depression in the FFS sample, the HOS 2002-2004 Cohort 5 data were analyzed. Using two or three depression-screening questions from the HOS, the statistical results for cutoff scores are similar. A score above 42 appears to better meet the criteria for an acceptable cutoff score. For example, the areas under the ROC curve produce *c* statistics of over 0.70. The balance between sensitivity and specificity, in both sets of analyses, is best achieved for scores of 51 or 52. However, the results of the HOS decile analysis indicate that a score of approximately 49 may be an optimal threshold score, with statistical properties similar to scores of 51 or 52. A score of 49 corresponds to approximately 29 percent positive. However, it is important to note that depressed mood (assessed by the self-reported screening measures in the HOS) is different from a clinical diagnosis of depression. In sum, what seems to be evident from these results is that the optimal score appears to be higher than the current standard of 42.

The results from the current study support a using higher MCS cutoff score for the elderly population than the score found by Ware and Kosinski. In support of the findings here, interestingly, a recent study examined the five-item mental health subscale from the SF-36 in 1,444 functionally impaired community dwelling elderly patients. Depression was assessed with the Mini-International Neuropsychiatric Interview Major Depressive Episode module. This research found a cutoff score of 59/60 with an area under the ROC curve of 0.837 (sensitivity = 78.7 percent, and specificity = 72.1 percent; Friedman et al., 2005). The SF-36[®] Summary

Measures Manual indicates that the optimal mental health subscale cutoff score for the *mental health subscale* is 52 (Ware & Kosinski, 2001, p. 138).

POLICY IMPLICATIONS

Overall, the results of the current analyses point to interesting directions for detecting an optimal threshold for depression risk in elderly beneficiaries. A score of 48 represents reasonable predictive accuracy across the three definitions of depression and would imply screening for 20 percent of elderly beneficiaries. However, CMS may want to consider using self-reported data to identify risk for depression in the elderly, since underdiagnosis makes the use of clinical diagnostic information somewhat problematic, and undercoding of depression is high in claims data. Based on the current results, the traditional score of 42 appears to be too low for assessing elderly depression. Additionally, MCS threshold scores may differ depending on whether depression is clinically diagnosed, self-reported, or determined with a clinical interview. Future research could target beneficiary demographic indicators such as race, education, income, and physical health as predictors of MCS deciles. Results of this analysis would help inform CMS about the characteristics of who is undiagnosed in the Medicare population, as well as providing supplemental information for beneficiaries who would be most likely to fall in low MCS deciles. Future research should also target high-risk subgroups of elderly female beneficiaries (over 80 years of age). ROC analyses may provide different MCS threshold scores for these subgroups, which would improve estimation.

What is clear is that assessing depression in the Medicare elderly is important for physical and mental health outcomes. The Institute for Healthcare Improvement's comprehensive manual *Depression: Changing Practice, Changing Lives* provides standards of excellent care for people with depression (IHI, 2002). The "Care Model Checklist" includes specific models of care for the self-management of depression, decision support, clinical information systems, delivery system design, and the organization of health care within the facility and in the community. This training manual is the result of a collaborative effort among the National Association of Community Health Centers, The Robert Wood Johnson Foundation, the Substance Abuse and Mental Health Services Administration, the Health Resources and Services Administration, and the Bureau of Primary Health Care.

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LIMITATIONS

The current study is an important step toward identifying an appropriate MCS depression risk threshold for the Medicare population. However, several limitations are noteworthy.

First, beneficiaries were diagnosed with depression 12 months prior to the CAHPS survey or 12 months after the survey. It is possible, but not likely, that beneficiaries may have been treated for their depression, resulting in an increased MCS score (treatment information was not included in the original Depression and Diabetes Trend file from CMS). Additionally, we cannot assume that because there was a diagnosis there was treatment, or that the beneficiary complied with the treatment, which is often long and complex. For example, NCQA (2006) indicates that the successful pharmacological management of depression includes the following three components:

- Acute Phase: antidepressant medication and at least three follow-up visits during the 12-week acute phase after initial diagnosis.
- Continuation Phase: beneficiaries remained on antidepressant medication continuously the six months after initial diagnosis.
- Optimal Practitioner Contacts: three follow-up office visits in the 12-week acute treatment phase after a new diagnosis of depression.

In addition to treatment, patients must adhere to the medication regimen. However, a new study of managed care patient adherence to antidepressant therapy found that approximately 57 percent of patients were non-adherent to therapy (Cantrell et al., 2006). For these reasons, the likelihood of a substantially increased MCS score in the FFS data due to effective treatment and compliance would most likely be minimal.

Second, depression is particularly hard to diagnose in the elderly because it presents differently and is comorbid with many chronic conditions. Consequently, it is highly probable that depression is undercoded in outpatient claims data. Finally, we did not examine diagnosed depression by mode of survey administration or proxy status, because these variables were not available from the Depression and Diabetes file from CMS. It is possible that the ROC and decile analyses may differ depending on survey mode and whether the respondent was a proxy.

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APPENDIX

MEDICARE HEALTH OUTCOMES SURVEY
FINAL REPORT, TASK 5.20A

Table 1 Fee-For-Service Demographics					
	Diagnosed with Depression		Not Diagnosed with Depression		Effect Size
	N=18,524		N=252,955		
	Frequency	Percent ¹	Frequency	Percent	
Gender					
Male	6,201	33.5%	110,665	43.7%	0.211 *
Female	12,323	66.5%	142,290	56.3%	0.211 *
Missing/Total	0	/18,524	0	/252,955	
Age					
65 to 69 years	3,640	19.7%	65,508	25.9%	0.149
70 to 74 years	4,277	23.1%	70,052	27.7%	0.106
75 to 79 years	4,196	22.7%	57,069	22.6%	0.002
80 and over	6,411	34.6%	60,326	23.8%	0.238 *
Missing/Total	0	/18,524	0	/252,955	
Race/Ethnicity					
White	17,329	93.5%	230,657	91.2%	0.089
African American	769	4.2%	14,302	5.7%	0.070
Asian	81	0.4%	2,412	1.0%	0.063
Hispanic	205	1.1%	2,814	1.1%	0.001
North American Native	46	0.3%	476	0.2%	0.013
Other Race~	94	0.5%	2,294	0.9%	0.048
Missing/Total	0	/18,524	0	/252,955	
Education					
8th Grade or Less	2,861	15.4%	31,208	12.3%	0.090
Some High School	2,792	15.1%	35,354	14.0%	0.031
High School Graduate/GED	6,356	34.3%	86,955	34.4%	0.001
Some College or 2 Year Degree	3,266	17.6%	48,139	19.0%	0.036
4 Year College Graduate	1,295	7.0%	20,366	8.1%	0.040
More than a 4 Year College Degree	1,439	7.8%	24,300	9.6%	0.065
Missing/Total	515	/18,524	6,633	/252,955	
Who Completed Survey					
Respondent	11,254	60.8%	197,968	78.30%	0.384 *
Proxy	6,009	32.4%	40,405	16.00%	0.390 *
Missing/Total	1,261	/18,524	14,582	/252,955	
Medicaid Status					
Not a Medicaid Recipient	16,077	86.8%	234,368	92.7%	0.195
Receive Medicaid	2,447	13.2%	18,587	7.4%	0.195
Missing/Total	0	/18,524	0	/252,955	
Health Status					
	Mean	SD	Mean	SD	
PCS score	34.48	12.20	40.88	12.66	0.507 **
MCS score	47.61	11.03	54.27	8.37	0.776 ***
Missing/Total	0	/18,524	0	/252,955	

~ Includes unknown race.

* Small effect size $0.20 < h < 0.49$, for differences between diagnosed and non-diagnosed groups.

** Medium effect size $0.50 < h < 0.80$, for differences between diagnosed and non-diagnosed groups.

*** Large effect size > 0.80 , for differences between diagnosed and non-diagnosed groups.

¹ Percent is based on the number of persons who responded to the question.

Source: CMS/RTI Depression Diagnosis FFS Trend File with Depression and Diabetes Analysis Variables
Years 2000, 2001, and 2002.

Table 2 Prevalence of ICD-9 Diagnoses and Mean MCS Scores by Mental Diagnoses Among Fee-For-Service Beneficiaries *						
ICD-9 Diagnoses	Prevalence		Respondents with Diagnoses		Respondents without Diagnoses	
	Number of Enrollees	Percent of Sample	Mean MCS	SD	Mean MCS	SD
Bipolar disorder	1,077	0.40%	47.30	11.39	53.84	8.72
Schizophrenia	635	0.23%	47.14	11.18	53.83	8.73
Major depressive disorder	3,772	1.39%	45.55	11.46	53.93	8.64
Other nonorganic psychoses	4,056	1.49%	48.23	11.11	53.90	8.67
Depressive disorder	12,255	4.51%	47.26	11.05	54.13	8.49
Neurotic depression	3,102	1.14%	46.63	11.17	53.90	8.68
Chronic depressive personality disorder	9	0.00%	44.66	7.06	53.82	8.74
Prolonged depressive reaction	133	0.05%	44.83	11.04	53.82	8.74
Strict definition of depression	3,467	1.28%	45.53	11.48	53.92	8.65
Less strictive definition of depression	10,923	4.02%	47.14	11.18	54.10	8.51
Least strictive definition of depression	18,524	6.82%	47.61	11.03	54.27	8.37

* n=271,479

Table 3 MCS Cutoff Scores and Associated Predictive Accuracy and Percent Positive Based on Diagnosis of Depression Based on Least Restrictive Definition of Depression												
MCS Score	Percent Positive	c-statistic	Sensitivity	Specificity	Accuracy	Positive	Negative	True	False	False	True	
						Predictive Value	Predictive Value					Positives
23	0.69%	0.512	0.028	0.995	0.929	0.280	0.933	527	1,355	17,997	251,600	
24	0.77%	0.512	0.031	0.994	0.928	0.275	0.933	573	1,513	17,951	251,442	
25	0.87%	0.514	0.035	0.993	0.928	0.272	0.934	641	1,718	17,883	251,237	
26	0.98%	0.515	0.037	0.992	0.927	0.261	0.934	693	1,967	17,831	250,988	
27	1.10%	0.516	0.041	0.991	0.926	0.258	0.934	768	2,211	17,756	250,744	
28	1.31%	0.519	0.048	0.989	0.925	0.250	0.934	891	2,668	17,633	250,287	
29	1.60%	0.521	0.055	0.987	0.923	0.237	0.935	1,028	3,303	17,496	249,652	
30	1.94%	0.525	0.066	0.984	0.921	0.233	0.935	1,229	4,050	17,295	248,905	
31	2.42%	0.530	0.080	0.980	0.919	0.227	0.936	1,490	5,071	17,034	247,884	
32	2.93%	0.535	0.095	0.975	0.915	0.221	0.936	1,763	6,204	16,761	246,751	
33	3.50%	0.542	0.113	0.971	0.912	0.219	0.937	2,084	7,424	16,440	245,531	
34	4.20%	0.548	0.131	0.965	0.908	0.213	0.938	2,432	8,979	16,092	243,976	
35	5.00%	0.555	0.153	0.958	0.903	0.208	0.939	2,829	10,748	15,695	242,207	
36	5.84%	0.562	0.174	0.950	0.897	0.203	0.940	3,227	12,633	15,297	240,322	
37	6.84%	0.570	0.198	0.941	0.890	0.198	0.941	3,674	14,882	14,850	238,073	
38	7.69%	0.576	0.218	0.933	0.885	0.194	0.942	4,045	16,824	14,479	236,131	
39	8.64%	0.582	0.239	0.925	0.878	0.189	0.943	4,433	19,034	14,091	233,921	
40	9.56%	0.588	0.260	0.916	0.872	0.185	0.944	4,808	21,155	13,716	231,800	
41	10.49%	0.594	0.281	0.908	0.865	0.182	0.945	5,199	23,292	13,325	229,663	
42	11.43%	0.600	0.300	0.899	0.858	0.179	0.946	5,562	25,460	12,962	227,495	
43	12.44%	0.605	0.320	0.890	0.851	0.175	0.947	5,923	27,837	12,601	225,118	
44	13.48%	0.610	0.340	0.880	0.843	0.172	0.948	6,299	30,304	12,225	222,651	
45	14.69%	0.616	0.363	0.869	0.834	0.168	0.949	6,720	33,171	11,804	219,784	
46	16.05%	0.622	0.388	0.856	0.824	0.165	0.950	7,186	36,397	11,338	216,558	
47	17.67%	0.629	0.417	0.841	0.812	0.161	0.952	7,725	40,234	10,799	212,721	
48	19.49%	0.635	0.447	0.824	0.798	0.157	0.953	8,284	44,629	10,240	208,326	
49	21.58%	0.643	0.481	0.804	0.782	0.152	0.955	8,917	49,671	9,607	203,284	
50	24.00%	0.649	0.518	0.780	0.762	0.147	0.957	9,597	55,558	8,927	197,397	
51	26.72%	0.654	0.554	0.754	0.740	0.141	0.958	10,257	62,274	8,267	190,681	
52	29.57%	0.656	0.586	0.726	0.716	0.135	0.960	10,857	69,431	7,667	183,524	
53	32.94%	0.656	0.620	0.692	0.687	0.128	0.961	11,487	77,945	7,037	175,010	
54	37.19%	0.653	0.657	0.649	0.650	0.121	0.963	12,171	88,796	6,353	164,159	
55	41.04%	0.651	0.692	0.610	0.616	0.115	0.964	12,825	98,601	5,699	154,354	
56	48.44%	0.636	0.738	0.534	0.548	0.104	0.965	13,664	117,841	4,860	135,114	

Diagnosis of Depression (6.8%), n=18,524; Total N=271,479

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables
 Years 2000, 2001, 2002

Figure 3: MCS Cutoff Scores and Associated Predictive Accuracy Based on Diagnosis of Depression

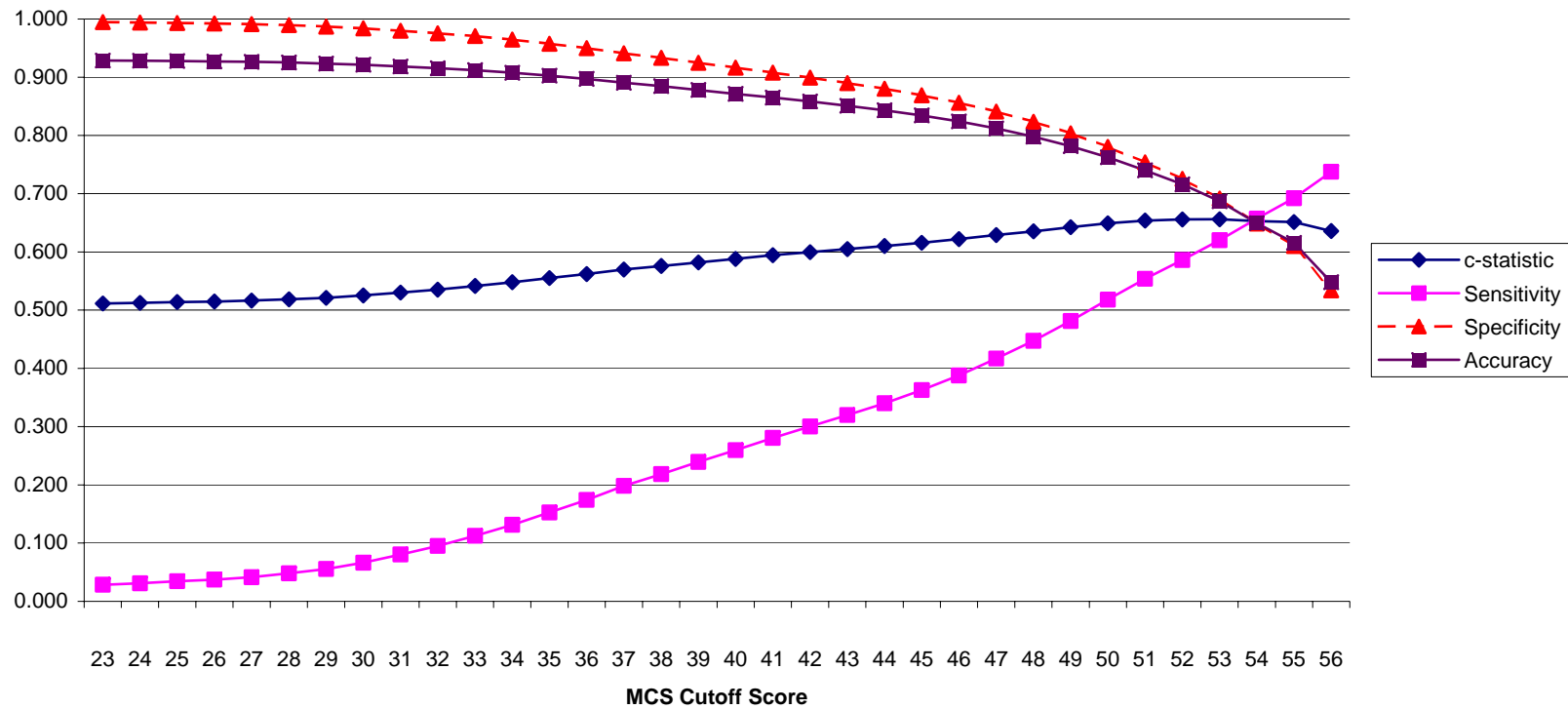


Table 4
Diagnosis of Depression by Decile
Based on Least Restrictive Definition of Depression

	Percentage	Mean MCS Score	Minimum	Maximum
Decile 1	18.48%	33.69	7.66	40.49
Decile 2	12.59%	44.93	40.49	48.24
Decile 3	9.28%	50.32	48.24	52.15
Decile 4	6.29%	53.49	52.15	54.74
Decile 5	4.50%	55.61	54.74	56.32
Decile 6	4.44%	57.08	56.32	57.83
Decile 7	2.76%	58.17	57.83	58.82
Decile 8	3.20%	59.56	58.82	60.17
Decile 9	3.00%	60.95	60.17	61.94
Decile 10	3.93%	64.22	61.94	79.59

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables, N=271,479

~ Deciles constructed using SAS PROC RANK

Decile 1 = lowest, Decile 10 = highest

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Table 5
MCS Cutoff Scores and Associated Predictive Accuracy and Percent Positive Based on Diagnosis of Depression
Based on Less Restrictive Definition of Depression

MCS Score	Percent Positive	c-statistic	Sensitivity	Specificity	Accuracy	Positive Predictive Value	Negative Predictive Value	True Positives	False Positives	False Negatives	True Negatives
23	0.69%	0.514	0.033	0.994	0.955	0.191	0.961	359	1,523	10,564	259,033
24	0.77%	0.515	0.036	0.993	0.955	0.187	0.961	390	1,696	10,533	258,860
25	0.87%	0.516	0.040	0.993	0.954	0.184	0.961	435	1,924	10,488	258,632
26	0.98%	0.517	0.043	0.992	0.953	0.176	0.961	467	2,193	10,456	258,363
27	1.10%	0.519	0.047	0.991	0.953	0.171	0.961	509	2,470	10,414	258,086
28	1.31%	0.520	0.052	0.989	0.951	0.160	0.961	571	2,988	10,352	257,568
29	1.60%	0.523	0.060	0.986	0.949	0.152	0.962	657	3,674	10,266	256,882
30	1.94%	0.527	0.071	0.983	0.946	0.148	0.962	780	4,499	10,143	256,057
31	2.42%	0.532	0.086	0.978	0.943	0.144	0.962	944	5,617	9,979	254,939
32	2.93%	0.538	0.102	0.974	0.939	0.140	0.963	1,113	6,854	9,810	253,702
33	3.50%	0.544	0.120	0.969	0.934	0.137	0.963	1,307	8,201	9,616	252,355
34	4.20%	0.551	0.140	0.962	0.929	0.134	0.964	1,528	9,883	9,395	250,673
35	5.00%	0.559	0.163	0.955	0.923	0.131	0.965	1,781	11,796	9,142	248,760
36	5.84%	0.567	0.186	0.947	0.916	0.128	0.965	2,036	13,824	8,887	246,732
37	6.84%	0.574	0.211	0.938	0.908	0.124	0.966	2,301	16,255	8,622	244,301
38	7.69%	0.580	0.231	0.930	0.901	0.121	0.966	2,521	18,348	8,402	242,208
39	8.64%	0.586	0.252	0.921	0.894	0.117	0.967	2,757	20,710	8,166	239,846
40	9.56%	0.593	0.273	0.912	0.886	0.115	0.968	2,985	22,978	7,938	237,578
41	10.49%	0.599	0.295	0.903	0.879	0.113	0.968	3,226	25,265	7,697	235,291
42	11.43%	0.605	0.316	0.894	0.871	0.111	0.969	3,449	27,573	7,474	232,983
43	12.44%	0.611	0.337	0.885	0.863	0.109	0.970	3,679	30,081	7,244	230,475
44	13.48%	0.617	0.359	0.875	0.854	0.107	0.970	3,917	32,686	7,006	227,870
45	14.69%	0.623	0.382	0.863	0.844	0.105	0.971	4,178	35,713	6,745	224,843
46	16.05%	0.628	0.407	0.850	0.832	0.102	0.972	4,443	39,140	6,480	221,416
47	17.67%	0.635	0.435	0.834	0.818	0.099	0.972	4,753	43,206	6,170	217,350
48	19.49%	0.640	0.464	0.816	0.802	0.096	0.973	5,071	47,842	5,852	212,714
49	21.58%	0.647	0.498	0.796	0.784	0.093	0.974	5,439	53,149	5,484	207,407
50	24.00%	0.654	0.536	0.772	0.763	0.090	0.975	5,852	59,303	5,071	201,253
51	26.72%	0.658	0.571	0.746	0.739	0.086	0.976	6,240	66,291	4,683	194,265
52	29.57%	0.661	0.604	0.717	0.713	0.082	0.977	6,600	73,688	4,323	186,868
53	32.94%	0.660	0.637	0.683	0.682	0.078	0.978	6,954	82,478	3,969	178,078
54	37.19%	0.656	0.672	0.641	0.642	0.073	0.979	7,338	93,629	3,585	166,927
55	41.04%	0.653	0.704	0.602	0.606	0.069	0.980	7,686	103,740	3,237	156,816
56	48.44%	0.640	0.752	0.527	0.536	0.062	0.981	8,218	123,287	2,705	137,269

Diagnosis of Depression (4.0%), n = 10,923; * N=271,479

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables
Years 2000, 2001, 2002

Figure 4: MCS Cutoff Scores and Associated Predictive Accuracy Based on Less Strictive Definition of Diagnosis of Depression

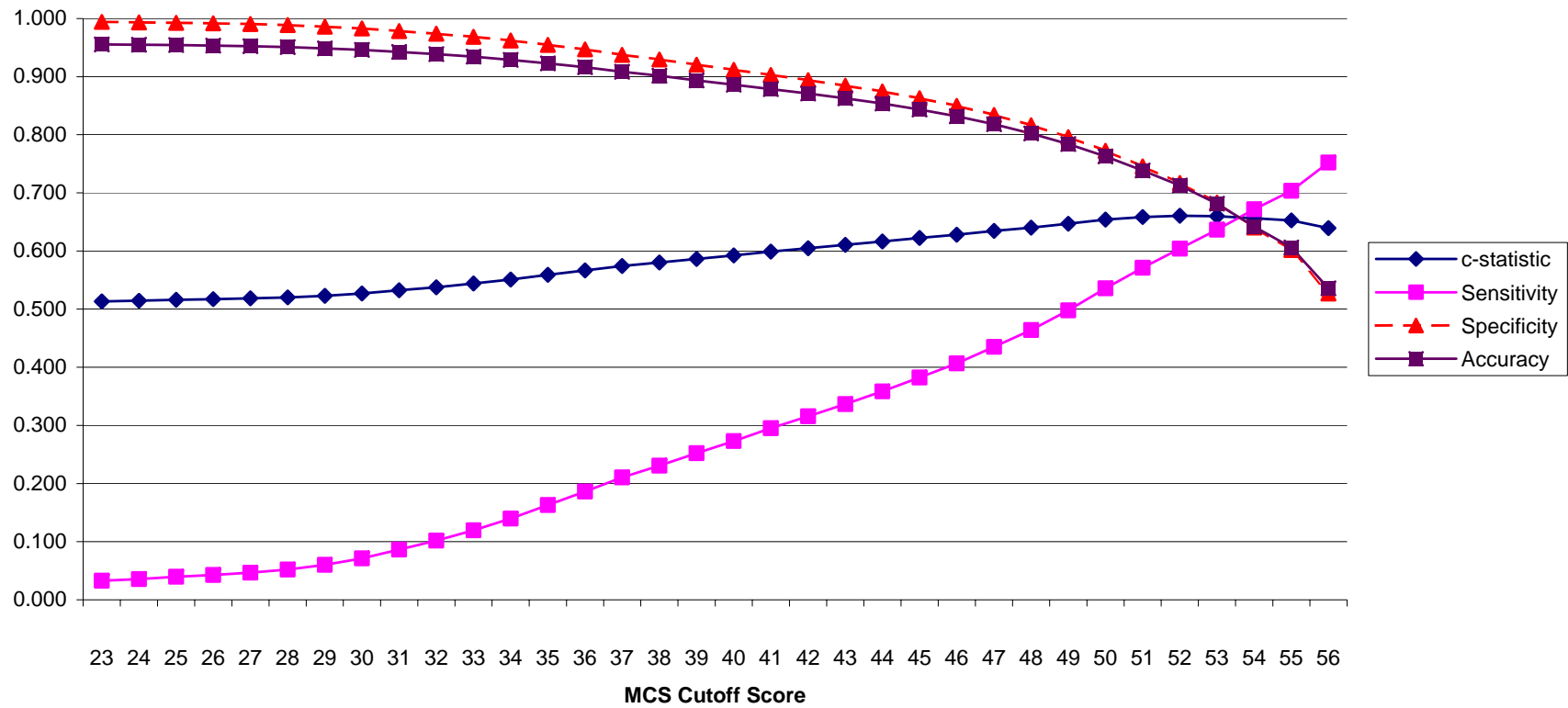


Table 6				
Diagnosis of Depression by Decile				
Based on Less Restrictive Definition of Depression				
	Percentage	Mean MCS Score	Minimum	Maximum
Decile 1	11.49%	33.69	7.66	40.49
Decile 2	7.47%	44.93	40.49	48.24
Decile 3	5.56%	50.32	48.24	52.15
Decile 4	3.49%	53.49	52.15	54.74
Decile 5	2.72%	55.61	54.74	56.32
Decile 6	2.37%	57.08	56.32	57.83
Decile 7	1.54%	58.17	57.83	58.82
Decile 8	1.86%	59.56	58.82	60.17
Decile 9	1.70%	60.95	60.17	61.94
Decile 10	2.15%	64.22	61.94	79.59

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables, n=271,479

~ Deciles constructed using SAS PROC RANK

Decile 1 = lowest, Decile 10 = highest

Table 7
MCS Cutoff Scores and Associated Predictive Accuracy and Percent Positive Based on Diagnosis of Depression
Based on Strict Definition of Depression

MCS Score	Percent Positive	c-statistic	Sensitivity	Specificity	Accuracy	Positive Predictive Value	Negative Predictive Value	True Positives	False Positives	False Negatives	True Negatives
23	0.69%	0.520	0.046	0.994	0.981	0.084	0.988	158	1,724	3,309	266,288
24	0.77%	0.521	0.050	0.993	0.981	0.082	0.988	172	1,914	3,295	266,098
25	0.87%	0.524	0.056	0.992	0.980	0.083	0.988	195	2,164	3,272	265,848
26	0.98%	0.525	0.059	0.991	0.979	0.077	0.988	206	2,454	3,261	265,558
27	1.10%	0.527	0.065	0.990	0.978	0.076	0.988	226	2,753	3,241	265,259
28	1.31%	0.529	0.071	0.988	0.976	0.069	0.988	247	3,312	3,220	264,700
29	1.60%	0.533	0.082	0.985	0.973	0.066	0.988	284	4,047	3,183	263,965
30	1.94%	0.538	0.094	0.982	0.970	0.062	0.988	327	4,952	3,140	263,060
31	2.42%	0.544	0.110	0.977	0.966	0.058	0.988	382	6,179	3,085	261,833
32	2.93%	0.550	0.128	0.972	0.961	0.056	0.989	445	7,522	3,022	260,490
33	3.50%	0.556	0.146	0.966	0.956	0.053	0.989	506	9,002	2,961	259,010
34	4.20%	0.563	0.167	0.960	0.949	0.051	0.989	578	10,833	2,889	257,179
35	5.00%	0.575	0.197	0.952	0.942	0.050	0.989	684	12,893	2,783	255,119
36	5.84%	0.584	0.224	0.944	0.935	0.049	0.989	778	15,082	2,689	252,930
37	6.84%	0.592	0.250	0.934	0.925	0.047	0.990	867	17,689	2,600	250,323
38	7.69%	0.600	0.274	0.926	0.917	0.045	0.990	949	19,920	2,518	248,092
39	8.64%	0.609	0.301	0.916	0.908	0.044	0.990	1,044	22,423	2,423	245,589
40	9.56%	0.617	0.326	0.907	0.900	0.044	0.990	1,131	24,832	2,336	243,180
41	10.49%	0.624	0.349	0.898	0.891	0.043	0.991	1,211	27,280	2,256	240,732
42	11.43%	0.630	0.372	0.889	0.882	0.042	0.991	1,289	29,733	2,178	238,279
43	12.44%	0.636	0.393	0.879	0.873	0.040	0.991	1,363	32,397	2,104	235,615
44	13.48%	0.641	0.414	0.869	0.863	0.039	0.991	1,435	35,168	2,032	232,844
45	14.69%	0.647	0.437	0.857	0.851	0.038	0.992	1,516	38,375	1,951	229,637
46	16.05%	0.653	0.462	0.843	0.838	0.037	0.992	1,602	41,981	1,865	226,031
47	17.67%	0.662	0.497	0.827	0.823	0.036	0.992	1,723	46,236	1,744	221,776
48	19.49%	0.667	0.524	0.809	0.806	0.034	0.992	1,817	51,096	1,650	216,916
49	21.58%	0.673	0.557	0.789	0.786	0.033	0.993	1,930	56,658	1,537	211,354
50	24.00%	0.680	0.594	0.765	0.762	0.032	0.993	2,061	63,094	1,406	204,918
51	26.72%	0.684	0.631	0.738	0.736	0.030	0.994	2,186	70,345	1,281	197,667
52	29.57%	0.684	0.660	0.709	0.708	0.028	0.994	2,288	78,000	1,179	190,012
53	32.94%	0.681	0.687	0.675	0.675	0.027	0.994	2,383	87,049	1,084	180,963
54	37.19%	0.676	0.718	0.633	0.634	0.025	0.994	2,491	98,476	976	169,536
55	41.04%	0.670	0.747	0.594	0.596	0.023	0.995	2,590	108,836	877	159,176
56	48.44%	0.659	0.799	0.520	0.523	0.021	0.995	2,771	128,734	696	139,278

Strict Diagnosis of Depression (1.3%), n = 3,467; N=271,479

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables

Years 2000, 2001, 2002

Figure 5: MCS Cutoff Scores and Associated Predictive Accuracy Based on Strict Definition of Diagnosis of Depression

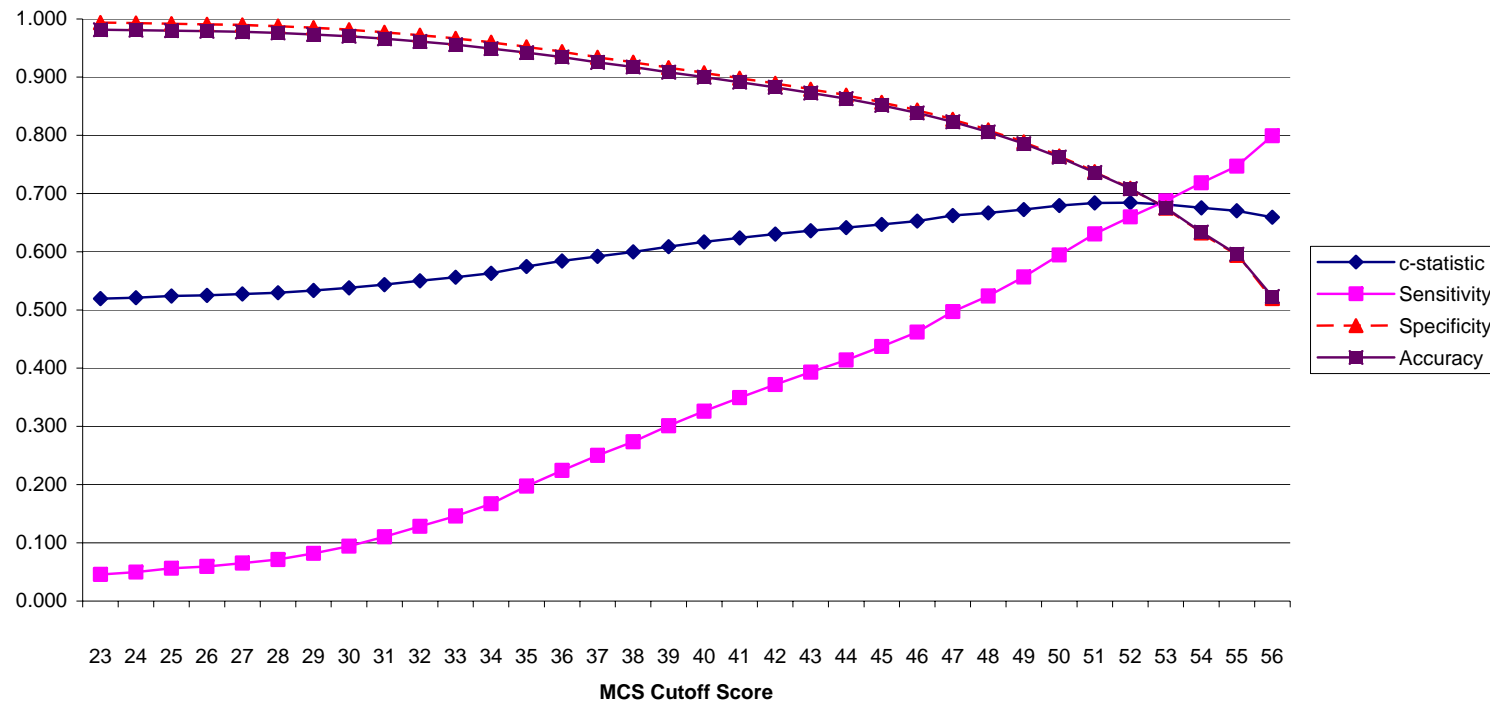


Table 8				
Diagnosis of Depression by Decile				
Based on Strict Definition of Depression				
	Percentage	Mean MCS Score	Minimum	Maximum
Decile 1	4.35%	33.69	7.66	40.49
Decile 2	2.44%	44.93	40.49	48.24
Decile 3	1.70%	50.32	48.24	52.15
Decile 4	0.95%	53.49	52.15	54.74
Decile 5	0.91%	55.61	54.74	56.32
Decile 6	0.59%	57.08	56.32	57.83
Decile 7	0.43%	58.17	57.83	58.82
Decile 8	0.46%	60.95	60.17	61.94
Decile 9	0.46%	60.95	60.17	61.94
Decile 10	0.52%	64.22	61.94	79.59

Source: CMS/RTI FFS Year 1,2,3 Trend File with Depression and Diabetes Analysis Variables, N=271,479

~ Deciles constructed using SAS PROC RANK

Decile 1 = lowest, Decile 10 = highest

MEDICARE HEALTH OUTCOMES SURVEY
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Table 9 MCS Cutoff Scores and Associated Predictive Accuracy and Percent Positive Based on Three Depression Screening Questions: Medicare Health Outcomes Survey													
MCS Score	Percent Positive	c-statistic	Sensitivity	Specificity	Accuracy	Positive Predictive		Negative Predictive		True	False	False	True
						Value	Value	Positives	Positives	Negatives	Negatives		
23	0.39%	0.508	0.016	1.000	0.763	0.960	0.762	191	8	11,969	38,398		
24	0.45%	0.509	0.018	1.000	0.764	0.956	0.763	217	10	11,943	38,396		
25	0.53%	0.510	0.021	1.000	0.764	0.959	0.763	255	11	11,905	38,395		
26	0.63%	0.512	0.025	1.000	0.765	0.950	0.764	301	16	11,859	38,390		
27	0.76%	0.515	0.030	0.999	0.766	0.938	0.765	362	24	11,798	38,382		
28	0.98%	0.518	0.038	0.999	0.768	0.929	0.766	461	35	11,699	38,371		
29	1.25%	0.523	0.048	0.999	0.770	0.927	0.768	584	46	11,576	38,360		
30	1.59%	0.529	0.060	0.998	0.773	0.912	0.770	734	71	11,426	38,335		
31	2.00%	0.536	0.074	0.997	0.775	0.889	0.773	901	112	11,259	38,294		
32	2.54%	0.544	0.092	0.996	0.779	0.875	0.776	1,123	160	11,037	38,246		
33	3.28%	0.554	0.115	0.993	0.782	0.847	0.780	1,404	253	10,756	38,153		
34	4.20%	0.567	0.144	0.990	0.787	0.824	0.785	1,749	373	10,411	38,033		
35	5.21%	0.580	0.174	0.987	0.791	0.804	0.791	2,120	516	10,040	37,890		
36	6.41%	0.595	0.209	0.982	0.796	0.784	0.797	2,541	702	9,619	37,704		
37	7.74%	0.610	0.244	0.975	0.800	0.759	0.803	2,972	942	9,188	37,464		
38	9.09%	0.623	0.278	0.968	0.802	0.736	0.809	3,379	1,215	8,781	37,191		
39	10.56%	0.638	0.316	0.961	0.806	0.719	0.816	3,839	1,503	8,321	36,903		
40	11.96%	0.649	0.347	0.952	0.807	0.697	0.822	4,214	1,832	7,946	36,574		
41	13.41%	0.660	0.378	0.943	0.807	0.677	0.827	4,594	2,187	7,566	36,219		
42	14.83%	0.671	0.408	0.934	0.807	0.662	0.833	4,962	2,537	7,198	35,869		
43	16.42%	0.681	0.439	0.923	0.806	0.643	0.839	5,335	2,968	6,825	35,438		
44	18.09%	0.691	0.471	0.911	0.805	0.626	0.845	5,724	3,425	6,436	34,981		
45	19.98%	0.698	0.500	0.895	0.800	0.602	0.850	6,082	4,020	6,078	34,386		
46	21.88%	0.707	0.533	0.881	0.797	0.586	0.856	6,481	4,583	5,679	33,823		
47	23.90%	0.714	0.564	0.864	0.792	0.568	0.862	6,863	5,223	5,297	33,183		
48	26.14%	0.722	0.598	0.845	0.786	0.550	0.869	7,270	5,946	4,890	32,460		
49	28.55%	0.729	0.633	0.825	0.778	0.533	0.876	7,696	6,740	4,464	31,666		
50	31.21%	0.732	0.664	0.799	0.767	0.512	0.883	8,080	7,702	4,080	30,704		
51	34.18%	0.733	0.696	0.770	0.752	0.490	0.889	8,460	8,822	3,700	29,584		
52	37.16%	0.732	0.725	0.740	0.736	0.469	0.895	8,811	9,979	3,349	28,427		
53	40.49%	0.730	0.754	0.705	0.717	0.448	0.900	9,165	11,311	2,995	27,095		
54	44.42%	0.725	0.787	0.664	0.694	0.426	0.908	9,566	12,893	2,594	25,513		
55	47.92%	0.719	0.812	0.626	0.671	0.407	0.913	9,870	14,363	2,290	24,043		
56	53.78%	0.704	0.847	0.560	0.629	0.379	0.921	10,304	16,891	1,856	21,515		

Positive Depression Screen (24.1%), n=12,160 Total N = 50,566

Source: Medicare HOS 2002 - 2004 Cohort 5 Merged File with 12-item health survey scoring

* A positive response to any of the 3 depression screening questions was considered to be a positive depression screen.

Depression Screen Questions: In the past year, have you had 2 weeks or more during which you felt sad, blue, or depressed; or when you lost interest or pleasure in things that you usually cared about or enjoyed?

In the past year, have you felt depressed or sad much of the time?

Have you ever had 2 years or more in your life when you felt depressed or sad most days, even if you felt okay sometimes?

Mean MCS score for beneficiaries with a positive depression screen is 44.87

Mean MCS score for beneficiaries without a positive depression screen is 55.03

Figure 6: MCS Cutoff Scores and Associated Predictive Accuracy Based on Three Depression Screening Questions:
 Medicare Health Outcomes Survey

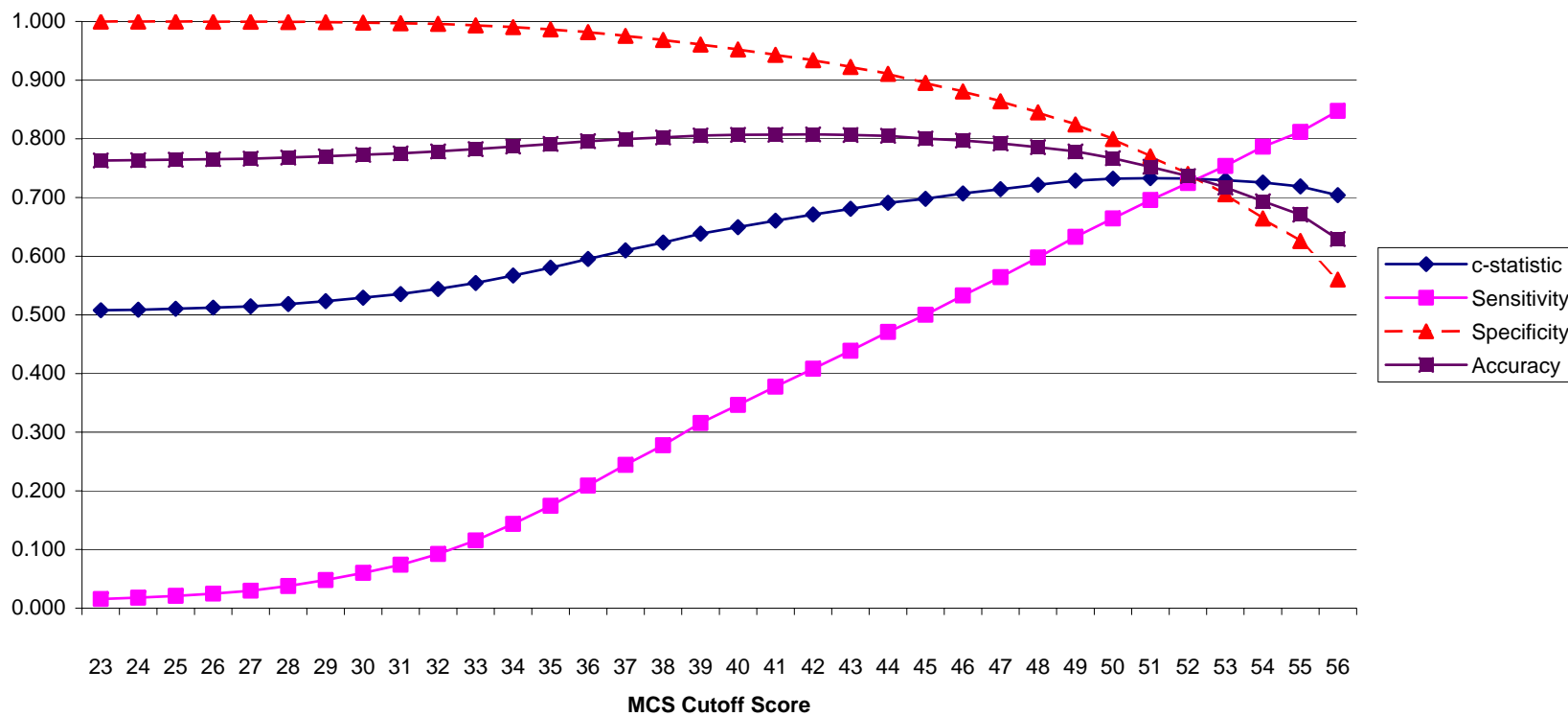


Table 10
Mean MCS Scores Based on Three Depression Screening Questions*
by Decile: Medicare Health Outcomes Survey

	Percentage	Mean MCS Score	Minimum	Maximum
Decile 1	72.78%	33.68	9.04	38.63
Decile 2	47.62%	42.00	38.63	45.01
Decile 3	36.37%	47.43	45.01	49.57
Decile 4	23.61%	51.27	49.57	52.87
Decile 5	17.78%	54.19	52.87	55.42
Decile 6	13.11%	56.36	55.42	57.19
Decile 7	7.08%	57.79	57.19	58.25
Decile 8	7.98%	59.02	58.25	59.78
Decile 9	6.29%	60.49	59.78	61.38
Decile 10	7.83%	63.57	61.39	78.81

Source: Medicare HOS 2002-2004 Cohort 5 with the 12-item health survey, N=50,566.

* A positive response to any of the three depression screening questions was considered to be a positive depression screen.

~ Deciles constructed using SAS PROC RANK

Decile 1 = lowest, Decile 10 = highest

Table 11
MCS Cutoff Scores and Associated Predictive Accuracy and Percent Positive Based on
Two Depression Screening Questions: Medicare Health Outcomes Survey

MCS Score	Percent Positive	c-statistic	Sensitivity	Specificity	Accuracy	Positive Predictive Value	Negative Predictive Value	True Positives	False Positives	False Negatives	True Negatives
23	0.39%	0.509	0.019	1.000	0.804	0.960	0.803	191	8	9,941	40,526
24	0.45%	0.511	0.021	1.000	0.804	0.956	0.803	217	10	9,915	40,524
25	0.53%	0.512	0.025	1.000	0.805	0.959	0.804	255	11	9,877	40,523
26	0.63%	0.515	0.030	1.000	0.806	0.947	0.805	301	17	9,831	40,517
27	0.76%	0.517	0.036	0.999	0.807	0.930	0.806	360	27	9,772	40,507
28	0.98%	0.522	0.045	0.999	0.808	0.919	0.807	456	40	9,676	40,494
29	1.24%	0.528	0.057	0.999	0.810	0.914	0.809	576	54	9,556	40,480
30	1.59%	0.535	0.072	0.998	0.813	0.900	0.811	725	81	9,407	40,453
31	2.00%	0.542	0.088	0.997	0.815	0.874	0.814	887	128	9,245	40,406
32	2.54%	0.552	0.109	0.996	0.818	0.861	0.817	1,106	179	9,026	40,355
33	3.27%	0.565	0.136	0.993	0.822	0.831	0.821	1,378	281	8,754	40,253
34	4.19%	0.579	0.168	0.990	0.825	0.804	0.826	1,707	417	8,425	40,117
35	5.20%	0.594	0.203	0.986	0.829	0.780	0.832	2,058	579	8,074	39,955
36	6.40%	0.611	0.242	0.980	0.833	0.755	0.838	2,449	796	7,683	39,738
37	7.73%	0.628	0.282	0.974	0.835	0.729	0.844	2,855	1,061	7,277	39,473
38	9.07%	0.643	0.319	0.966	0.837	0.704	0.850	3,236	1,361	6,896	39,173
39	10.55%	0.660	0.361	0.958	0.839	0.684	0.857	3,656	1,688	6,476	38,846
40	11.94%	0.671	0.393	0.949	0.838	0.659	0.862	3,984	2,063	6,148	38,471
41	13.39%	0.683	0.426	0.939	0.837	0.637	0.868	4,321	2,464	5,811	38,070
42	14.81%	0.694	0.458	0.929	0.835	0.619	0.873	4,643	2,860	5,489	37,674
43	16.39%	0.704	0.491	0.918	0.832	0.599	0.878	4,974	3,332	5,158	37,202
44	18.07%	0.715	0.525	0.905	0.829	0.581	0.884	5,321	3,836	4,811	36,698
45	19.96%	0.723	0.556	0.890	0.823	0.557	0.889	5,635	4,477	4,497	36,057
46	21.86%	0.732	0.590	0.874	0.817	0.540	0.895	5,977	5,101	4,155	35,433
47	23.88%	0.740	0.622	0.857	0.810	0.521	0.901	6,303	5,796	3,829	34,738
48	26.12%	0.747	0.657	0.838	0.801	0.503	0.907	6,653	6,582	3,479	33,952
49	28.54%	0.755	0.693	0.816	0.792	0.486	0.914	7,021	7,439	3,111	33,095
50	31.20%	0.758	0.725	0.791	0.778	0.465	0.920	7,343	8,465	2,789	32,069
51	34.16%	0.759	0.755	0.762	0.761	0.442	0.926	7,653	9,654	2,479	30,880
52	37.15%	0.758	0.784	0.732	0.742	0.422	0.931	7,939	10,882	2,193	29,652
53	40.48%	0.753	0.810	0.696	0.719	0.400	0.936	8,206	12,303	1,926	28,231
54	44.40%	0.747	0.840	0.655	0.692	0.378	0.942	8,510	13,988	1,622	26,546
55	47.92%	0.739	0.862	0.616	0.666	0.360	0.947	8,735	15,545	1,397	24,989
56	53.77%	0.721	0.891	0.551	0.619	0.331	0.953	9,026	18,218	1,106	22,316

Positive Depression Screen (20.0%), n= 10,132 Total N = 50,666

Source: Medicare HOS 2002-2004 Cohort 5 Merged File with 12-item health survey scoring

* A positive response to either of 2 depression screening questions was considered to be a positive depression screen.

Depression Screen Questions: In the past year, have you had 2 weeks or more during which you felt sad, blue, or depressed; or when you lost interest or pleasure in things that you usually cared about or enjoyed?

In the past year, have you felt depressed or sad much of the time?

Mean MCS score for those with a positive depression screen is 43.48

Mean MCS score for those without a positive depression screen is 54.87

Figure 7: MCS Cutoff Scores and Associated Predictive Accuracy Based on Two Depression Screening Questions: Medicare Health Outcomes Survey

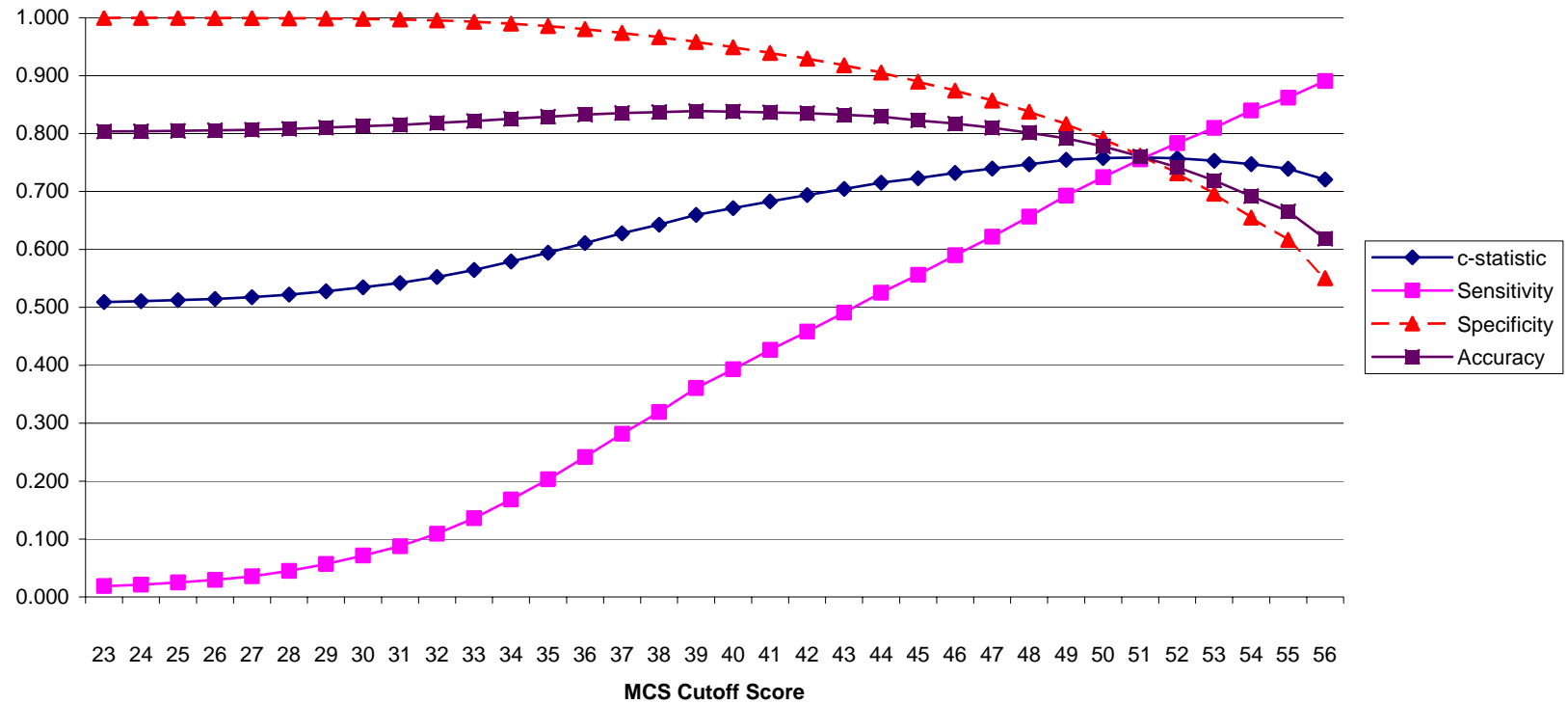


Table 12
Mean MCS Scores Based on Two Depression Screening Questions*
by Decile: Medicare Health Outcomes Survey

	Percentage	Mean MCS Score	Minimum	Maximum
Decile 1	69.38%	33.68	9.04	38.63
Decile 2	41.97%	42.00	38.63	45.01
Decile 3	31.10%	47.43	45.01	49.57
Decile 4	18.86%	51.27	49.57	52.87
Decile 5	13.13%	54.19	52.87	55.42
Decile 6	8.68%	56.36	55.42	57.19
Decile 7	4.57%	57.79	57.19	58.25
Decile 8	4.53%	59.02	58.25	59.78
Decile 9	3.42%	60.49	59.78	61.38
Decile 10	4.30%	63.57	61.39	78.81

* n = 50,566

Source: Medicare HOS 2002-2004 Cohort 5 with the 12-item health survey, N=50,566.

* A positive response to the two depression screening questions, omitting lifetime depression question, was considered to be a positive depression screen

~ Deciles constructed using SAS PROC RANK

Decile 1 = lowest, Decile 10 = highest

Table 13				
Optimal Cutoff MCS Scores and Percent Positive based on Fee-For-Service and Managed Care Beneficiaries				
Depression Diagnosis Standard	Optimal MCS cut-off point based on C-statistic		Optimal MCS cut-off point based on McCaffery and Elliot's Approach	
	MCS Cutoff Score	Percent Screened Positive	MCS Cutoff Score	Percent Screened Positive
<u>Depression Based on Claims*</u>				
Strict definition of depression	50	24.00%	48	19.49%
Less strictive definition of depression	51	26.72%	48	19.49%
Least strictive definition of depression	52	29.57%	48	19.49%
<u>Self-reported depression**</u>				
Two-item positive depression questions	49	28.55%	49	28.55%
Three-item positive depression questions	49	28.55%	49	28.55%

* n=271,479

** n= 50,566