Change in the Quality of Care Delivered to Medicare Beneficiaries, 1998-1999 to 2000-2001

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Context Despite widespread concern regarding the quality and safety of health care, and a Medicare Quality Improvement Organization (QIO) program intended to improve that care in the United States, there is only limited information on whether quality is improving.

Objective To track national and state-level changes in performance on 22 quality indicators for care of Medicare beneficiaries.

Design, Patients, and Setting National observational cross-sectional studies of national and state-level fee-for-service data for Medicare beneficiaries during 1998-1999 (baseline) and 2000-2001 (follow-up).

Main Outcome Measures Twenty-two QIO quality indicators abstracted from statewide random samples of medical records for inpatient fee-for-service care and from Medicare beneficiary surveys or Medicare claims for outpatient care. *Absolute improvement* is defined as the change in performance from baseline to follow-up (measured in percentage points for all indicators except those measured in minutes); *relative improvement* is defined as the absolute improvement divided by the difference between the baseline performance and perfect performance (100%).

Results The median state's performance improved from baseline to follow-up on 20 of the 22 indicators. In the median state, the percentage of patients receiving appropriate care on the median indicator increased from 69.5% to 73.4%, a 12.8% relative improvement. The average relative improvement was 19.9% for outpatient indicators combined and 11.9% for inpatient indicators combined ($P<.001$). For all but one indicator, absolute improvement was greater in states in which performance was low at baseline than those in which it was high at baseline (median $r=-0.43$; range: 0.12 to −0.93). When states were ranked on each indicator, the state's average rank was highly stable over time ($r=0.93$ for 1998-1999 vs 2000-2001).

Conclusions Care for Medicare fee-for-service plan beneficiaries improved substantially between 1998-1999 and 2000-2001, but a much larger opportunity remains for further improvement. Relative rankings among states changed little. The improved care is consistent with QIO activities over this period, but these cross-sectional data do not provide conclusive information about the degree to which the improvement can be attributed to the QIOs' quality improvement efforts.

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HEALTH CARE IN THE UNITED States can be improved substantially, and even people with apparently good access to care receive care that falls far short of what it could be. In the area of public health and prevention, *Healthy People 2010*[1] showed wide gaps between public health performance and actual achievements on many quality indicators, including some delivered by the fee-for-service health care system. Two years ago, a report from the Institute of Medicine showed serious problems of harm to patients from medical errors[2]; last year another Institute of Medicine report, *Crossing the Quality Chasm*,[3] identified major system problems as the principal source of many errors. In 2000, Congress instructed the Agency for Health Care Research and Quality to prepare an annual report on quality of health care in the United States, and the first of these reports is scheduled to be made public next year.

In 2000, the Health Care Financing Administration (now the Centers for Medicare & Medicaid Services) reported on 24 indicators of the quality of care delivered to Medicare beneficiaries (primarily in fee-for-service) in 1998-1999.[4] These indicators measure delivery of services that evidence shows to be effective in preventing or treating breast cancer, diabetes, myocardial infarction, heart failure, pneumonia, and stroke.[4] This report provides follow-up data on care given in 2000-2001 and makes comparisons with the 1998-1999 baseline data.

For editorial comment see p 354.

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METHODS

The tracking system used for the 1998-1999 data that was first reported in 2000 is used again for the 2000-2001 data in this report. This system is used in evaluation of the Medicare Quality Improvement Organizations (QIOs) and is independent of them.

TABLE 1 summarizes the clinical topics, quality indicators, sampling frame, and data sources that were used for the baseline article and are used again herein. The quality indicators and their rationale have been described in the 2000 report.[4] The Medicare Quality Improvement Organization program tracks 24 quality indicators through contracted data abstraction centers, surveys, and analysis of claims data. Two of these (time to thrombolysis and time to angioplasty) are shown in TABLE 2 but are not analyzed herein (they were not in the 2000 report) because the number of cases observed in most states was quite small.

We followed the same fee-for-service sampling strategy and data collection procedures as were first reported for the baseline data with 2 exceptions. Information on influenza

Table 1. Quality Indicators for Care of Medicare Fee-for-Service Beneficiaries

Topic	Indicator	Short Name	Sampling Frame for Denominator	Data Source
Inpatient setting				
Acute myocardial infarction	Administration of aspirin within 24 h of admission	Aspirin 24 h	All Medicare patients with principal discharge diagnosis of acute myocardial infarction and no contraindications	Systematic random sample of up to 750 inpatient records per state
	Aspirin prescribed at discharge 24 h	Aspirin disch		
	Administration of β-blocker within 24 h of admission	BB 24 h		
	β-Blocker prescribed at discharge	BB disch		
	ACE Inhibitor prescribed at discharge for patients with left ventricular ejection fraction <0.40	ACEI in AMI		
	Smoking cessation counseling given during hospitalization	Smoking		
	Time to angioplasty, min	PTCA, min		
	Time to thrombolytic therapy, min	Thrombolytic, min		
Heart failure	Evaluation of ejection fraction	LVEF	All Medicare patients with principal discharge diagnosis of heart failure	Systematic random sample of up to 800 inpatient records per state
	ACE Inhibitor prescribed at discharge for patients with left ventricular ejection fraction <0.40	ACEI in HF		
Stroke	Warfarin prescribed for patients with atrial fibrillation	Afibrillation	All Medicare patients with any discharge diagnosis of atrial fibrillation	Systematic random sample of up to 750 inpatient records per state
	Antithrombotic prescribed at discharge for patients with acute stroke or transient ischemic attack	Antithrombotic	All Medicare patients with principal discharge diagnosis of stroke (nifedipine and antithrombotic) or transient ischemic attack (antithrombotic)	Systematic random sample of up to 750 inpatient records per state
	Avoidance of sublingual nifedipine for patients with acute stroke	Nifedipine		
Pneumonia	Antibiotic within 8 h of arrival at hospital	Antibiotic time	All Medicare patients with a discharge diagnosis of pneumonia	Systematic random sample of up to 750 inpatient records per state
	Antibiotic consistent with current recommendations	Antibiotic Rx		
	Blood culture drawn (if done) before antibiotic given	Blood culture		
	Patient screened for or given influenza vaccine	Flu screen		
	Patient screened for or given pneumococcal vaccine	Pneu screen		
Any setting				
Pneumonia	Influenza immunization every year	Flu immun	All noninstitutionalized persons aged ≥65 y (includes managed care)	Behavioral Risk Factor Surveillance System for 1998-1999; similar CMS survey for 2000-2001
	Pneumococcal immunization at least once ever	Pneu immun		
Breast cancer	Mammogram at least every 2 y	Mammography	All female Medicare beneficiaries aged 52-69 y	All Medicare claims
Diabetes	Hemoglobin A_{1c} at least every y	HbA_{1c}	All Medicare patients with 2 ambulatory diagnoses or 1 inpatient diagnosis of diabetes	All Medicare claims
	Eye exam at least every 2 y	Eye exam		
	Lipid profile at least every 2 y	Lipid profile		

Abbreviations: BB, β-blocker; ACE, angiotensin-converting enzyme; PTCA, percutaneous coronary intervention; CMS, Centers for Medicare & Medicaid Services.

Table 2. Quality Indicator Averages (Absolute Change From Baseline) by State, 2000-2001*

State	Average State Ranks		Quality Indicators												
			Acute Myocardial Infarction								Congestive Heart Failure		Stroke		
	1998-1999	2000-2001	Aspirin 24 h	Aspirin Disch	BB 24 h	BB Disch	ACEI in AMI	Smoking	Thrombolysis, min	PTCA, min	LVEF	ACEI in HF	Afibrillation	Antithrombotic	Nifedipine
Alabama	46	42	**80** (2)	**87** (1)	**58** (3)	78 (18)	**69** (6)	38 (4)	*35* (–18)	*100* (1)	***69*** (4)	**70** (8)	**53** (3)	***84*** (4)	100 (4)
Alaska	22	33	82 (–5)	86 (–10)	78 (–1)	*67* (–6)	*100* (18)	*61* (24)	*57* (3)	*90* (–13)	70 (19)	*58* (–33)	**52** (–1)	84 (–2)	97 (4)
Arizona	25	29	***84*** (–3)	**84** (–2)	**65** (2)	84 (16)	69 (1)	32 (–21)	*55* (–3)	*103* (–4)	***81*** (11)	**61** (–4)	**55** (–2)	***89*** (7)	**99** (8)
Arkansas	50	48	**78** (3)	**84** (6)	**50** (–5)	57 (–6)	69 (12)	39 (15)	*37* (–5)	*109* (15)	***60*** (8)	43 (–22)	**51** (0)	***80*** (3)	100 (8)
California	39	44	***87*** (2)	**86** (2)	**66** (6)	66 (–2)	70 (4)	31 (–10)	*77* (41)	*146* (39)	***66*** (4)	70 (5)	**52** (8)	***77*** (2)	**96** (9)
Colorado	9	7	***92*** (6)	**93** (3)	**75** (10)	92 (16)	82 (8)	53 (6)	*51* (13)	*121* (42)	***69*** (4)	65 (–7)	**65** (8)	***85*** (1)	**100** (6)
Connecticut	6	9	***89*** (–3)	**86** (–5)	**78** (10)	83 (8)	**80** (6)	39 (–2)	*39* (2)	*101* (–7)	***79*** (2)	69 (–4)	**64** (7)	***90*** (0)	**100** (2)
Delaware	12	14	**88** (2)	**96** (10)	**69** (7)	84 (12)	82 (10)	33 (–37)	*28* (–22)	*67*	**77** (3)	78 (5)	**55** (5)	***89*** (3)	**99** (1)
District of Columbia	31	37	**87** (–10)	**91** (8)	69 (–5)	85 (–7)	78 (5)	39 (12)		*177* (127)	**75** (4)	72 (–4)	**55** (1)	***82*** (3)	**99** (0)
Florida	40	41	***80*** (3)	**79** (1)	**65** (4)	79 (10)	60 (–10)	33 (3)	*45* (9)	*95* (–36)	***76*** (6)	**70** (4)	**61** (5)	***80*** (1)	**97** (6)
Georgia	48	47	**73** (–6)	**84** (3)	**58** (–4)	74 (6)	71 (3)	38 (4)	*38* (4)	*110* (6)	***68*** (5)	64 (–3)	**51** (1)	***80*** (1)	**100** (9)
Hawaii	23	16	**90** (6)	**83** (2)	**62** (6)	84 (33)	79 (4)	50 (14)	*79* (35)	*96* (21)	**82** (7)	74 (3)	**47** (2)	**90** (1)	**100** (3)
Idaho	19	22	**90** (3)	**87** (2)	**66** (–4)	84 (11)	78 (19)	44 (–12)	*30* (–8)	*107* (–32)	***58*** (4)	73 (–15)	**56** (–1)	***83*** (3)	**99** (1)
Illinois	47	46	***83*** (7)	**80** (4)	**67** (0)	75 (20)	73 (–1)	35 (6)	*51* (30)	*110* (–51)	***67*** (2)	68 (7)	**57** (2)	***83*** (3)	99 (7)
Indiana	29	27	**83** (–1)	**89** (2)	**69** (8)	83 (12)	79 (12)	55 (2)	*35* (2)	*165* (45)	***71*** (6)	60 (–5)	**62** (7)	***84*** (3)	**98** (5)
Iowa	8	6	**85** (1)	**88** (2)	**78** (14)	89 (10)	77 (2)	41 (4)	*51* (8)	*104* (–29)	***66*** (13)	70 (–1)	**60** (3)	***83*** (–1)	100 (1)
Kansas	34	30	***84*** (5)	**84** (0)	**68** (14)	74 (15)	67 (9)	51 (8)	*49* (4)	*134* (49)	***59*** (1)	60 (–10)	**53** (2)	***86*** (10)	**97** (8)
Kentucky	37	40	**85** (5)	**81** (–2)	**65** (2)	80 (7)	66 (–4)	**52** (16)	*32* (2)	*71* (–48)	***63*** (1)	52 (–10)	**54** (3)	***84*** (1)	100 (9)
Louisiana	49	51	***85*** (4)	**81** (2)	**65** (7)	71 (–2)	65 (1)	25 (–15)	*44* (11)	*105* (11)	***66*** (6)	58 (12)	**49** (2)	***74*** (–1)	100 (6)
Maine	3	3	**89** (4)	**91** (4)	**82** (1)	91 (7)	82 (14)	49 (–12)	*38* (13)		73 (6)	71 (–1)	**60** (–1)	***89*** (2)	**99** (1)
Maryland	24	25	**85** (–1)	**87** (3)	**71** (2)	77 (1)	79 (0)	27 (–13)	*30* (–24)	*83* (–86)	75 (2)	61 (–4)	**55** (2)	***84*** (3)	**99** (1)
Massachusetts	4	15	**87** (0)	**86** (–2)	**82** (9)	88 (–4)	72 (–7)	45 (1)	*45* (4)	*135*	***80*** (4)	**65** (3)	**66** (2)	***91*** (5)	**99** (3)
Michigan	28	26	***85*** (1)	**90** (4)	**70** (3)	93 (20)	82 (8)	43 (1)	*49* (11)	*110* (–29)	***70*** (1)	68 (6)	**57** (6)	***86*** (7)	**99** (3)
Minnesota	7	10	**88** (–2)	**83** (–6)	**80** (14)	87 (3)	69 (–11)	51 (13)	*42* (2)	*117* (21)	***64*** (3)	69 (–1)	**62** (3)	***89*** (1)	**100** (3)
Missouri	35	28	**81** (5)	**88** (10)	**67** (8)	78 (7)	**74** (0)	**54** (16)	*80* (36)	*124* (–255)	***73*** (7)	71 (12)	**58** (6)	***83*** (–1)	**99** (7)
Montana	17	13	**88** (2)	**89** (–1)	**70** (17)	71 (–1)	71 (13)	46 (–17)	*44* (–3)	*87* (0)	***58*** (11)	77 (7)	**62** (3)	***86*** (1)	**99** (3)
Mississippi	51	50	**80** (0)	**84** (7)	**60** (16)	66 (19)	66 (5)	43 (9)	*38* (11)	*141* (–51)	***61*** (2)	55 (–6)	**54** (7)	***80*** (6)	**100** (2)
Nebraska	27	12	**85** (1)	**89** (4)	**74** (8)	74 (–9)	81 (13)	51 (14)	*41* (2)	*107* (–311)	***74*** (3)	69 (–7)	**67** (9)	***90*** (6)	**95** (7)
Nevada	36	35	**88** (5)	**84** (4)	**59** (1)	69 (–1)	73 (–4)	45 (1)	*45* (–7)	*178* (70)	***82*** (0)	62 (–13)	**56** (14)	***81*** (3)	**96** (9)
New Hampshire	1	1	**92** (4)	**93** (2)	**86** (11)	89 (–1)	87 (6)	36 (–13)	*35* (–14)	*260* (159)	**82** (1)	77 (2)	**70** (8)	***86*** (1)	**100** (1)
New Jersey	41	43	**76** (–1)	**65** (–10)	**61** (–4)	68 (–1)	64 (4)	31 (–7)	*47* (3)	*128* (10)	***72*** (6)	59 (6)	**55** (0)	73 (0)	99 (3)
New Mexico	32	36	**89** (4)	**89** (2)	**65** (12)	74 (12)	67 (–10)	53 (3)	*43* (6)	*94* (–46)	***58*** (3)	70 (–14)	**58** (1)	***77*** (–1)	**97** (6)
New York	30	24	***84*** **(1)**	**84** (3)	**81** (14)	85 (12)	76 (1)	36 (–13)	*44* (–9)	*100* (6)	***81*** (4)	76 (–8)	**62** (7)	***84*** (2)	100 (2)
North Carolina	18	23	**84** (3)	**92** (3)	**69** (4)	81 (2)	76 (–1)	47 (13)	*58* (27)	*95* (–29)	***74*** (15)	65 (3)	**53** (–7)	***87*** (0)	**98** (1)
North Dakota	5	4	**92** (7)	**92** (5)	**75** (6)	84 (–3)	65 (–16)	42 (13)	*103* (60)	*73* (–122)	**45** (5)	68 (–10)	**64** (–1)	***90*** (4)	**100** (5)
Ohio	33	38	**83** (–5)	**83** (–3)	**72** (10)	79 (6)	64 (–7)	25 (–2)	*42* (–11)	*82* (10)	***75*** (5)	57 (–7)	**62** (10)	***84*** (4)	**98** (6)
Oklahoma	44	45	**83** (5)	**82** (3)	**57** (12)	76 (13)	76 (6)	39 (14)	*46* (8)	*59* (–25)	***59*** (7)	56 (–10)	**50** (–2)	***76*** (4)	97 (7)
Oregon	20	11	***87*** (1)	**87** (3)	**79** (10)	80 (3)	78 (8)	45 (–8)	*38* (–2)	*77* (–25)	***70*** (11)	76 (7)	**56** (–1)	***82*** (4)	**100** (6)
Pennsylvania	16	31	**85** (3)	**85** (4)	**68** (–3)	79 (–9)	63 (–21)	26 (–15)	*50* (11)	*103* (–88)	*77* (3)	**61** (–12)	**63** (2)	***86*** (1)	**99** (0)
Puerto Rico	52	52	***70*** (4)	**69** (10)	**53** (20)	67 (14)	65 (6)	33 (3)	*78* (12)	*230*	***56*** (12)	61 (2)	***39*** (8)	***76*** (3)	98 (0)
Rhode Island	15	17	**88** (6)	**88** (1)	**81** (6)	95 (16)	84 (1)	31 (5)	*38* (–2)	*106* (–158)	**79** (2)	74 (–6)	**65** (5)	***86*** (–2)	**98** (3)
South Carolina	38	32	**83** (3)	**85** (5)	**70** (12)	76 (6)	79 (20)	**34** (9)	*45* (–10)	*78* (–481)	***73*** (6)	60 (–6)	**59** (7)	***90*** (7)	**100** (1)
South Dakota	26	20	**89** (6)	**92** (4)	**70** (1)	82 (11)	75 (8)	52 (15)	*121* (57)	*163* (–117)	***61*** (10)	56 (–10)	**69** (8)	***90*** (6)	**97** (7)
Tennessee	42	39	**78** (–5)	**84** (0)	**63** (7)	75 (9)	71 (4)	**39** (–5)	*41* (15)	*170* (64)	***67*** (0)	66 (15)	**46** (–15)	***81*** (5)	100 (6)
Texas	45	49	**83** (5)	**75** (–9)	**65** (14)	72 (14)	64 (1)	37 (18)	*54* (16)	*111* (26)	***65*** (1)	58 (–4)	**48** (4)	***80*** (8)	**98** (8)
Utah	14	5	**87** (3)	**93** (3)	**75** (17)	88 (20)	78 (–1)	61 (10)	*30* (–20)	*89* (–64)	***71*** (14)	73 (–6)	**65** (8)	***88*** (2)	**98** (7)
Vermont	2	2	**92** (6)	**90** (1)	82 (4)	*86* (7)	70 (–2)	56 (–3)	*48* (–1)	*230* (45)	**81** (10)	81 (4)	**66** (8)	**88** (2)	99 (1)
Virginia	21	18	**89** (4)	**90** (6)	**67** (2)	88 (11)	78 (11)	53 (10)	*51* (6)	*141* (–23)	***80*** (3)	**73** (–1)	**56** (–4)	***88*** (–2)	**98** (0)
Washington	13	19	**92** (6)	**87** (–1)	**71** (4)	78 (12)	71 (–5)	51 (–9)	*50* (4)	*98* (–23)	***69*** (6)	61 (–19)	**59** (9)	***83*** (–1)	**100** (6)
West Virginia	43	34	**85** (1)	**86** (1)	**65** (13)	62 (–3)	65 (1)	51 (8)	*40* (–21)	*122* (–15)	***58*** (–4)	53 (–5)	**56** (11)	***87*** (1)	**100** (7)
Wisconsin	11	8	**86** (1)	**87** (–1)	**74** (3)	79 (–6)	75 (10)	58 (16)	*49* (16)	*108* (–104)	***72*** (5)	72 (–3)	**65** (5)	***86*** (2)	**100** (5)
Wyoming	10	21	95 (4)	91 (–4)	71 (1)	*62* (0)	*89* (–1)	44 (–22)	*33* (–3)	*116* (–41)	**42** (8)	*82* (3)	**65** (7)	**82** (2)	98 (–2)
Median			85 (3)	86 (2)	69 (6)	79 (7)	74 (4)	43 (3)	45 (4)	107 (–19)	70 (4)	68 (–4)	57 (3)	84 (2)	99 (4)

(continued)

Table 2. Quality Indicator Averages (Absolute Change From Baseline) by State, 2000-2001* (cont)

	Pneumonia					Immunizations		Breast Cancer	Diabetes		
State	Antibiotic Time	Antibiotic Rx	Blood Culture	Flu Screen	Pneu Screen	Flu Immun	Pneu Imm	Mammography	$HgbA_{1c}$	Eye Exam	Lipid Profile
Alabama	***87*** (0)	***84*** (7)	***74*** (–5)	**26** (13)	***30*** (20)	***65*** (1)	***54*** (0)	***60*** (4)	***70*** (12)	***64*** (1)	***65*** (18)
Alaska	**91** (4)	**83** (8)	**89** (–5)	**30** (6)	**27** (9)	***67*** (7)	***66*** (22)	***55*** (3)	***71*** (2)	***57*** (1)	***69*** (13)
Arizona	***86*** (4)	***90*** (12)	***80*** (–8)	***37*** (10)	***40*** (18)	***69*** (–2)	***68*** (15)	***60*** (3)	***71*** (4)	***64*** (–1)	***72*** (16)
Arkansas	***87*** (–1)	***83*** (6)	***83*** (1)	**12** (6)	***8*** (4)	***74*** (6)	***63*** (12)	***55*** (5)	***69*** (12)	***70*** (3)	***64*** (21)
California	***88*** (4)	***83*** (16)	***82*** (–5)	**12** (2)	***12*** (6)	***73*** (1)	***66*** (9)	***56*** (3)	***73*** (8)	***70*** (0)	***77*** (16)
Colorado	***88*** (2)	***85*** (1)	***82*** (–3)	***30*** (10)	***31*** (12)	***78*** (3)	***69*** (6)	***60*** (5)	***84*** (7)	***69*** (2)	***74*** (23)
Connecticut	***90*** (5)	***84*** (9)	***83*** (–2)	**35** (12)	***27*** (9)	***72*** (8)	***66*** (17)	***63*** (3)	***80*** (7)	***77*** (0)	***76*** (14)
Delaware	***87*** (5)	***89*** (8)	***79*** (–8)	**22** (9)	***19*** (8)	***72*** (4)	***69*** (3)	***64*** (5)	***80*** (10)	***76*** (1)	***82*** (26)
District of Columbia	***82*** (5)	***82*** (10)	***65*** (–2)	**27** (5)	***25*** (9)	***61*** (5)	***48*** (13)	***52*** (1)	***65*** (5)	***69*** (0)	***68*** (16)
Florida	***80*** (4)	***84*** (10)	***79*** (–3)	**14** (8)	***18*** (15)	***66*** (3)	***61*** (8)	***65*** (3)	***79*** (10)	***75*** (0)	***83*** (14)
Georgia	***83*** (0)	***84*** (7)	**81** (1)	**14** (3)	***17*** (9)	***71*** (14)	***63*** (13)	***57*** (5)	***74*** (11)	***63*** (1)	***67*** (15)
Hawaii	***89*** (–1)	***80*** (1)	**87** (2)	**23** (12)	***22*** (11)	***78*** (4)	***75*** (19)	***57*** (5)	***82*** (9)	***72*** (4)	***82*** (11)
Idaho	***89*** (0)	***88*** (10)	**84** (0)	**24** (12)	***29*** (19)	***72*** (3)	***59*** (4)	***60*** (5)	***82*** (5)	***69*** (1)	***75*** (16)
Illinois	***86*** (1)	***85*** (8)	**77** (–1)	**21** (8)	***17*** (8)	***69*** (1)	***59*** (11)	***58*** (4)	***74*** (11)	***66*** (3)	***69*** (20)
Indiana	***84*** (3)	***84*** (5)	**83** (5)	**36** (8)	***37*** (11)	***73*** (7)	***61*** (10)	***60*** (6)	***77*** (10)	***65*** (1)	***73*** (15)
Iowa	***90*** (3)	***88*** (10)	***90*** (4)	**33** (12)	***31*** (12)	***78*** (8)	***68*** (7)	***65*** (5)	***85*** (7)	***78*** (1)	***74*** (14)
Kansas	***89*** (0)	***85*** (8)	***82*** (–4)	**30** (11)	***24*** (13)	***72*** (5)	***67*** (12)	***64*** (6)	***83*** (8)	***77*** (2)	***70*** (20)
Kentucky	***85*** (2)	***85*** (5)	**82** (1)	**22** (5)	***25*** (11)	***66*** (–2)	***58*** (6)	***59*** (6)	***75*** (12)	***65*** (1)	***74*** (15)
Louisiana	***84*** (3)	***81*** (9)	**79** (–3)	**7** (–1)	***7*** (3)	***65*** (4)	***59*** (18)	***55*** (6)	***69*** (12)	***63*** (1)	***71*** (17)
Maine	***90*** (1)	***82*** (4)	***84*** (–2)	***39*** (0)	***28*** (9)	***75*** (2)	***65*** (7)	***71*** (6)	***85*** (9)	***81*** (3)	***76*** (16)
Maryland	***83*** (3)	***88*** (6)	***77*** (–4)	**31** (17)	***28*** (18)	***72*** (9)	***67*** (13)	***61*** (3)	***77*** (7)	***69*** (1)	***79*** (17)
Massachusetts	***88*** (2)	***85*** (4)	***75*** (–10)	***19*** (6)	***16*** (7)	***79*** (9)	***71*** (14)	***66*** (2)	***83*** (6)	***76*** (0)	***69*** (13)
Michigan	***82*** (–2)	***84*** (13)	**76** (–4)	**29** (10)	***28*** (14)	***72*** (2)	***63*** (5)	***67*** (3)	***78*** (6)	***66*** (1)	***70*** (15)
Minnesota	***88*** (1)	***86*** (11)	**81** (–4)	**33** (–5)	***26*** (4)	***78*** (14)	***68*** (16)	***67*** (5)	***87*** (5)	***79*** (4)	***76*** (17)
Missouri	***83*** (–2)	***85*** (6)	**79** (–1)	**14** (3)	***11*** (5)	***70*** (7)	***60*** (10)	***52*** (5)	***65*** (14)	***65*** (4)	***59*** (20)
Montana	***84*** (0)	***84*** (4)	***79*** (2)	**28** (12)	***25*** (10)	***77*** (9)	***64*** (11)	***59*** (5)	***78*** (6)	***68*** (1)	***71*** (14)
Mississippi	***93*** (0)	***88*** (9)	**89** (1)	**30** (15)	***24*** (13)	***74*** (1)	***68*** (7)	***65*** (6)	***81*** (11)	***74*** (2)	***74*** (24)
Nebraska	***91*** (3)	***87*** (5)	**83** (2)	**28** (13)	***33*** (21)	***79*** (10)	***70*** (15)	***63*** (7)	***77*** (6)	***77*** (1)	***69*** (15)
Nevada	***82*** (–4)	***87*** (7)	***72*** (–4)	**22** (11)	***46*** (35)	***62*** (–1)	***65*** (3)	***56*** (6)	***78*** (8)	***65*** (1)	***77*** (15)
New Hampshire	***90*** (1)	***83*** (8)	***87*** (–2)	**32** (–5)	***23*** (4)	***76*** (11)	***66*** (6)	***68*** (5)	***87*** (5)	***78*** (2)	***77*** (17)
New Jersey	***85*** (6)	***85*** (11)	***82*** (3)	**35** (23)	***33*** (25)	***68*** (3)	***60*** (6)	***54*** (4)	***73*** (11)	***72*** (0)	***79*** (14)
New Mexico	***87*** (0)	***85*** (15)	***83*** (–3)	**26** (2)	***24*** (6)	***72*** (3)	***64*** (11)	***56*** (5)	***71*** (6)	***63*** (0)	***66*** (16)
New York	***81*** (1)	***83*** (13)	***77*** (–1)	**37** (23)	***32*** (20)	***70*** (6)	***64*** (14)	***58*** (2)	***76*** (11)	***73*** (2)	***76*** (20)
North Carolina	***83*** (–1)	***85*** (4)	**84** (5)	**20** (1)	***19*** (7)	***72*** (9)	***70*** (11)	***62*** (6)	***81*** (11)	***72*** (2)	***75*** (21)
North Dakota	***90*** (–1)	***86*** (1)	**83** (6)	**33** (6)	***30*** (11)	***78*** (10)	***68*** (13)	***71*** (6)	***87*** (6)	***80*** (3)	***80*** (16)
Ohio	***83*** (2)	***82*** (10)	**80** (–2)	**30** (7)	***20*** (7)	***69*** (0)	***63*** (8)	***61*** (5)	***78*** (13)	***69*** (2)	***75*** (23)
Oklahoma	***86*** (3)	***83*** (3)	***83*** (–3)	**27** (11)	***33*** (19)	***78*** (6)	***69*** (15)	***55*** (6)	***72*** (9)	***61*** (0)	***68*** (14)
Oregon	***92*** (2)	***85*** (7)	***89*** (1)	**33** (19)	***20*** (7)	***77*** (12)	***67*** (11)	***64*** (5)	***85*** (6)	***73*** (2)	***74*** (22)
Pennsylvania	***86*** (1)	***79*** (0)	***87*** (–1)	**22** (10)	***17*** (8)	***74*** (11)	***66*** (13)	***60*** (4)	***80*** (10)	***71*** (1)	***78*** (18)
Puerto Rico	***47*** (9)	***69*** (15)	***63*** (–2)	**37** (30)	***37*** (32)	***40*** (–1)	***31*** (9)	***52*** (6)	***55*** (15)	***53*** (0)	***64*** (22)
Rhode Island	***89*** (8)	***92*** (8)	***76*** (–5)	**22** (12)	***23*** (16)	***73*** (–3)	***62*** (5)	***62*** (4)	***80*** (10)	***79*** (1)	***76*** (21)
South Carolina	***81*** (1)	***84*** (5)	**83** (–3)	**15** (7)	***17*** (11)	***76*** (6)	***66*** (10)	***61*** (5)	***77*** (10)	***68*** (3)	***72*** (16)
South Dakota	***90*** (–1)	***85*** (0)	**85** (1)	***22*** (8)	***22*** (8)	***78*** (4)	***56*** (6)	***65*** (8)	***80*** (8)	***71*** (1)	***69*** (13)
Tennessee	***87*** (8)	***84*** (4)	**79** (0)	**24** (14)	***24*** (16)	***74*** (9)	***68*** (14)	***58*** (6)	***78*** (12)	***62*** (1)	***71*** (23)
Texas	***82*** (2)	***84*** (5)	***81*** (–3)	**17** (5)	***17*** (9)	***69*** (–1)	***62*** (6)	***56*** (5)	***75*** (6)	***65*** (–1)	***77*** (14)
Utah	***90*** (1)	***86*** (1)	**84** (2)	**52** (33)	***49*** (32)	***74*** (–1)	***64*** (3)	***60*** (6)	***85*** (6)	***72*** (3)	***77*** (22)
Vermont	***88*** (–1)	***81*** (0)	***87*** (–2)	**33** (0)	***17*** (0)	***77*** (4)	***69*** (12)	***68*** (5)	***87*** (4)	***76*** (1)	***75*** (19)
Virginia	***87*** (2)	***88*** (4)	***84*** (2)	**21** (11)	***26*** (17)	***74*** (8)	***63*** (8)	***60*** (5)	***80*** (9)	***70*** (1)	***74*** (16)
Washington	***91*** (3)	***80*** (7)	***83*** (–4)	**24** (2)	***24*** (8)	***72*** (4)	***67*** (11)	***64*** (5)	***86*** (5)	***74*** (2)	***78*** (18)
West Virginia	***86*** (2)	***81*** (1)	**80** (–2)	**35** (27)	***29*** (23)	***70*** (7)	***64*** (10)	***61*** (6)	***77*** (15)	***65*** (3)	***75*** (23)
Wisconsin	***88*** (1)	***88*** (10)	**88** (6)	**29** (6)	***25*** (8)	***77*** (12)	***68*** (14)	***67*** (7)	***86*** (6)	***74*** (1)	***76*** (15)
Wyoming	***90*** (–2)	***86*** (–1)	**87** (–1)	**18** (5)	***20*** (11)	***74*** (1)	***68*** (7)	***62*** (7)	***76*** (13)	***71*** (3)	***59*** (18)
Median	87 (2)	85 (7)	82 (–2)	**27** (9)	24 (11)	72 (5)	65 (10)	60 (5)	78 (8)	70 (1)	74 (16)

*For an explanation of abbreviations, see Table 1. For details of indicators, see Table 1. Values are percentage of patients receiving appropriate care except for Thrombolysis and PTCA, which are reported in minutes. A blank indicates that there were no cases in the sample that met the selection criteria. Typeface indicates number of cases on which value is based: italic, 1-30 cases; regular, 31-100 cases; bold, 101-200 cases; bold italic, 301 or more cases.

and pneumococcal vaccination rates came from a specially contracted survey using the influenza and pneumococcal vaccination items from the Behavioral Risk Factor Surveillance System (BRFSS) and designed to emulate the BRFSS sampling strategy as closely as possible. This was done because appropriately timed data from the regularly scheduled BRFSS were not available.[5] We also substituted the 1999 BRFSS data for the earlier 1997 BRFSS data in our baseline rates because these later data represent state rates during the 1998-1999 baseline period better than the 1997 data. In addition, we made minor corrections in the claims processing algorithms used to construct the diabetes indicators for the 1998-1999 period. These changes resulted in small, nonmaterial, changes in the baseline rates first reported in the 2000 report. The corrected baseline rates for the immunization and diabetes indicators are used to make comparisons with the follow-up performance from the 2000-2001 period.

Reliability was calculated as the percentage agreement on all abstraction data elements between 2 blinded, independent abstractors at different abstraction centers. Each abstraction center also performed internal reliability assessments on a monthly random sample of 30 cases taken from abstracts completed during the previous month.[6]

Absolute improvement is defined as the change in performance from baseline to follow-up (measured in percentage points for all indicators except those measured in minutes); *relative improvement* is defined as the absolute improvement divided by the difference between the baseline performance and perfect performance (100%); relative improvement can also be called the decrease in the error or failure rate. The definition of relative improvement differs from the usual method of using the baseline rate as the denominator. We used this definition because dividing by the baseline rate exaggerates small changes for poorly performing states while minimizing changes in states that already perform well.

Performance was calculated at the state level for each of the quality indicators. For the 22 quality indicators discussed herein, results were calculated as the percentage of patients who had no contraindications and who received the indicated treatment. We direct our attention both to variation among states (including the District of Columbia and Puerto Rico) and to national trends. Therefore, we calculated for each indicator both performance of the median state and the national average (weighted by the number of aged Medicare beneficiaries in each state). We calculated the SD of each indicator rate across the set of states. To summarize the overall changes we observed on each indicator, we calculated the absolute and relative improvement on the indicator in the median state. To summarize the overall changes that we observed within each state, we calculated a median amount of absolute and relative improvement across the set of indicators in the state. Finally, we characterized the median absolute and relative national improvement as the median of these state medians.

We also calculated the rank of each state on each quality indicator based on performance rates during the 2000-2001 follow-up period and the rank on each quality indicator based on the amount of relative improvement observed. We then calculated the average rank for each state across the 22 quality indicators and arrayed the states according to their average rank, again based on their performance rates during the 2000-2001 follow-up period. We ranked states in a similar way on the amount of relative improvement. The changes in data described above and changes in our algorithm for breaking ties on ranking resulted in slight changes of ranking for 1998-1999 from those reported in the earlier article.

We tested the equality of the relative improvement for the inpatient indicators (the first 16 indicators in Table 1) and outpatient indicators (the last 6 indicators in Table 1) using a *t* test without assumption of equal variances and treating each indicator rate in each state as an observation.

RESULTS

The reliability of data elements used to construct quality indicators based on medical record abstraction ranged from 80% to 95% with a median interrater reliability of 90%.

Table 2 shows the 2000-2001 performance and change from baseline for each indicator in each state. Across the 1144 pairs of baseline vs re-measurement comparisons (ie, 52 states and territories × 22 indicators), absolute increases in performance occurred in 81% (925/1144) of the observations (χ^2_1 = 240.8; $P<.001$). For all 22 indicators, state performance at baseline predicted performance at follow-up, generally quite powerfully (median r=0.74; range: 0.29-0.98). A state's average rank on the 22 indicators was highly stable over time (r=0.93 for 1998-1999 vs 2000-2001). For all but one indicator, absolute improvement was greater when performance was low at baseline than when it was high at baseline (median r=–0.43; range: 0.12 to –0.93); a similar pattern occurred for state performance as measured by performance on the median indicator in the state (r, –0.30) and for indicator performance as measured by the median state's performance (r, –0.43).

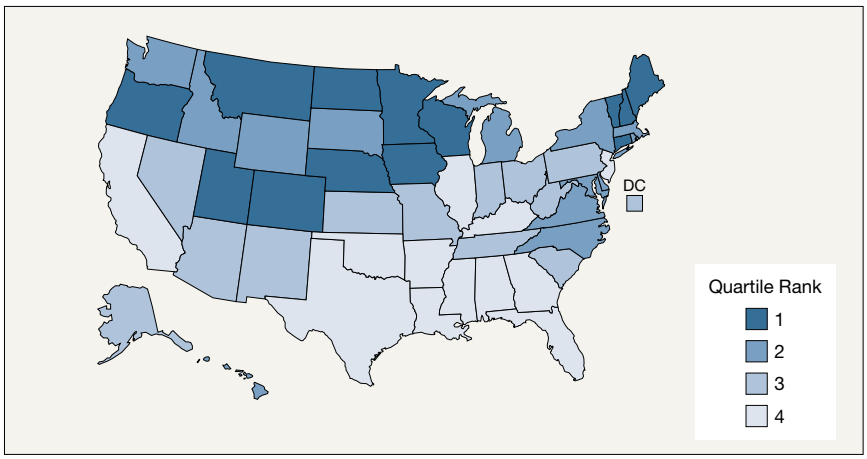
TABLE 3 shows summary statistics for each indicator for the country as a whole. The performance of the median state as well as the weighted national average improved on 20 of the 22 indicators (all but use of angiotensin-converting enzyme inhibitors in heart failure and performance of blood culture prior to starting antibiotics in pneumonia). Performance in the median state on the median indicator was 69.5% appropriate care in 1998-1999 and 73.4% in 2000-2001; the median absolute improvement was 3.9%, and the median relative improvement was 12.8%. The average relative improvement was 19.9% for outpatient indicators combined and 11.9% for inpatient indicators combined ($P<.001$).

Table 3. National Summary of Quality Indicators and Changes, 1998-1999 to 2000-2001*

	Inpatient Setting																	Any Setting					
	Acute Myocardial Infarction								Congestive Heart Failure		Stroke			Pneumonia					Adult Immunization		Breast Cancer	Diabetes		
Variables	Aspirin 24 h	Aspirin Disch	BB 24 h	BB Disch	ACEI in AMI	Smoking	Thrombolysis, min	PTCA, min	LVEF	ACEI in HF	Afibrillation	Antithrombotic	Nifedipine	Antibiotic Time	Antibiotic Rx	Blood Culture	Flu Screen	Pneu Screen	Flu Immun	Pneu Imm	Mammography	$HgbA_{1c}$	Eye Exam	Lipid Profile
Median state rate																								
1998-1999	84	85	64	72	71	40	41	120	65	69	55	83	95	85	79	82	14	11	67	55	55	70	68	74
2001-2000	85	86	69	79	74	43	45	107	70	68	57	84	99	87	85	82	27	24	72	65	60	78	70	60
Weighted average 2000-2001	84	84	68	78	71	38	50	114	71	66	57	83	99	85	84	81	24	23	71	64	77	70	74	16
Improvement																								
Median	3	2	6	7	4	3	4	–19	5	–4	3	2	4	2	7	–2	9	11	5	10	5	8	1	16
Weighted	2	1	6	7	0	0	9	–17	8	–2	4	3	5	2	8	–2	9	12	5	10	4	9	1	17
Median relative†	15	14	17	28	10	5	NA	NA	14	–10	7	12	77	10	32	–9	10	12	16	22	11	29	4	38
Weighted average relative	10	6	17	23	1	0	NA	NA	22	–6	8	13	78	12	34	–9	11	13	14	22	10	28	3	40
SD																								
1998-1999	5.0	5.7	9.1	10.2	7.7	11.6	9.7	93.0	10.0	8.4	6.3	4.7	3.5	7.6	5.4	5.1	8.2	5.2	5.9	7.0	4.6	8.4	5.9	6.5
2000-2001	4.9	5.6	7.9	8.7	7.7	9.6	17.8	41.4	9.2	8.2	6.5	4.4	1.3	6.3	3.4	5.3	8.5	8.4	6.3	6.6	4.7	6.6	6.1	5.3
Correlation of 1998-1999 with 2000-2001	.73	.71	.74	.54	.41	.31	.29	–.07	.90	.41	.71	.83	.58	.94	.64	.78	.56	.48	.75	.77	.96	.94	.98	.84
Correlation of improvement with baseline	–.39	–.41	–.52	–.60	–.53	–.68	–.27	–.93	–.41	–.56	–.35	–.39	–.93	–.60	–.79	–.26	–.44	–.16	–.27	–.42	–.07	–.71	.12	–.58

*See Table 1 for explanation of abbreviations.
†Relative improvement is calculated as improvement/(100 – baseline improvement).

Figure 1. State Ranking on Provision of Appropriate Care, 2000-2001



States are ranked according to their average performance across indicators in 2000-2001.

FIGURE 1 shows the national pattern of performance in 2000-2001 (follow-up). As in the previous report on 1998-1999, better performance is concentrated in northern states and less populous states. FIGURE 2 shows the pattern of relative improvement. Geographic trends are similar but less marked than for follow-up performance.

COMMENT

We believe this is the first national study to show improvement in quality of care over time for multiple conditions in inpatient and outpatient settings. However, these quality indicators give a somewhat unbalanced picture of Medicare services. They overrepresent inpatient and preventive services, underrepresent ambulatory care, and represent very few interventional procedures. This study is also generally limited to care delivered in fee-for-service Medicare. Nationally, about 85% of Medicare beneficiaries are cared for under fee-for-service care and about 15% under managed care, but in Arizona, California, Florida, and Pennsylvania more than 25% of beneficiaries are enrolled in managed care. Comparing Health Employer Data and Information Set (HEDIS) data from managed care with this fee-for-service Medicare data presents technical problems that we have not yet solved for these measures, but HEDIS data for managed care demonstrate similar trends.[7] Furthermore, because of technical challenges such as risk adjustment, we focused on measuring processes of care critical to outcomes rather than on measuring outcomes themselves.

Growing national alarm over unrealized opportunities to improve care has been accompanied by a significant improvement in care, although far more remains to be done than has been accomplished. The improvement reported herein is consistent with the goals of the Medicare QIO program, which has performance-based con-

tracts with QIOs to achieve precisely these kinds of improvement.[8] The QIO program has created the performance measurement system that tracks progress on these topics and has dramatically heightened national awareness of the opportunity for improvement. However, these cross-sectional data do not provide conclusive information about the degree to which the improvement can be attributed to the QIOs' quality improvement efforts. There is evidence that QIO interventions can cause improvement,[9] but the effort during the period of this study was national, with no control group, and the strong emphasis on partnerships for improvement makes isolating the contribution of the QIO program almost impossible. Indeed, using a clinical model to conduct research that will prove linkages between interventions (such as fail-safe systems) and improved quality faces many of the same difficulties as using a clinical research model to study many aspects of patient safety.[10] Nor does current evidence allow us to estimate how much of the improvement reported herein may be attributed to heightened awareness of specific clinical treatments and how much may be attributed to changes in health care systems.

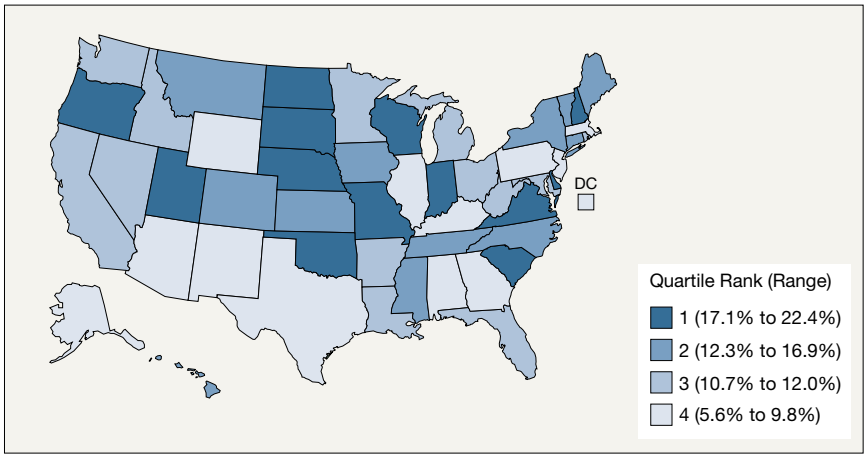
Ten years ago, Rogers et al[11] and Kahn et al[12] reported an improvement in quality of inpatient care for Medicare beneficiaries with 5 conditions during the mid 1980s. Our study suggests that this trend continues and is broader. However, despite this evidence, a wide gap remains between the care that could be delivered and the care that is delivered to Medicare beneficiaries. In part the explanation for this discrepancy is that the diffusion of standards of care is relatively slow, that new standards are developed continually, and that the performance gap is very wide compared with progress. The greatest improvements in inpatient care were (1) prescription of β-blockers for patients with acute myocardial infarction at discharge, (2) delivering antibiotics within 8 hours of reaching the hospital for patients with pneumonia, and (3) avoiding the administration of sublingual nifedipine to patients with acute stroke. Yet, in 2000-2001, 21% of patients with myocardial infarction and without contraindication to β-blockers were still discharged without a prescription and 13% of patients with pneumonia still waited more than 8 hours for antibiotics. By contrast, the number of patients receiving sublingual nifedipine dropped by 77% to about 1%, and the measure has been dropped from QIO contracts because so little opportunity for improvement remains. Growing evidence suggests that improvement and adoption of best practices is limited or promoted by the systems within which care is delivered and that we cannot close those gaps unless we change the systems.[3] Although it is risky to generalize from these few examples, it seems intuitive that changing the system to prevent doing something risky would be easier than changing it to do something of potential benefit both reliably and promptly.

Centers for Medicare & Medicaid Services is dropping stroke from the QIO contracts because there seems to be little further systemic improvement to be achieved on use of sublingual nifedipine and because clinically valid abstraction of eligibility for warfarin use in patients with atrial fibrillation is very difficult.

Centers for Medicare & Medicaid Services will be adding 3 indicators related to patient safety in the inpatient setting: use of appropriate antibiotics for prophylaxis against surgical infection, appropriate timing of the administration of those antibiotics, and appropriate discontinuation after surgery.[13,14] Centers for Medicare & Medicaid Services and the Joint Commission on Accreditation of Healthcare Organizations have modified their performance indicators to make them virtually identical for areas that both organizations cover. Quality Improvement Organizations will also extend their work to improving performance on quality indicators for both nursing homes and home health agencies. The National Quality Forum endorsed a group of indicators for hospitals in 2002[15] and is scheduled to endorse additional hospital measures, as well as nursing home measures, in 2003. Quality Improvement Organizations will also be working to help hospitals collect their own data, with the hope that those hospitals will soon decide to publish their performance data.[16] The health care system still urgently needs systems that will help it to keep up with change and needs partnerships among those who support quality improvement to move it forward more rapidly.[17]

The findings of this study are encouraging in showing that improvement is possible and is taking place. They should not lead to complacency:

Figure 2. Median Relative Improvement in the Provision of Appropriate Care



Relative improvement is calculated as improvement/(100 – baseline improvement).

there is still a very long way to go, and medicine is changing at least as fast as our progress in implementing what was the standard of care just a few years ago.

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Acquisition of data: Jencks, Huff, Cuerdon.
Analysis and interpretation of data: Jencks, Huff, Cuerdon.
Drafting of the manuscript: Jencks, Cuerdon.
Critical revision of the manuscript for important intellectual content: Jencks, Huff, Cuerdon.
Statistical expertise: Huff, Cuerdon.
Obtained funding: Jencks.
Administrative, technical, or material support: Huff, Cuerdon.
Study supervision: Jencks, Cuerdon.
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True science teaches, above all, to doubt and to be ignorant.
—Miguel de Unamuno (1864-1936)

tent of several generic and proprietary antiretroviral formulations containing the non-nucleoside reverse transcriptase inhibitor nevirapine.

Methods. Tablets containing nevirapine (alone or in combination with other antiretroviral agents) were obtained from 6 international sources, representing 4 countries and 3 manufacturers (TABLE). Medications were obtained in April 2002 from physicians from South Africa, Zambia, Lithuania, and Kenya who were attending an HIV educational training program at the National Institutes of Health in Bethesda, Md. All tablets were obtained from local pharmacies. The nevirapine content of the 6 products was determined by high-performance liquid chromatography.[4] Calibration and quality control standards of known concentrations were prepared for quantitative analysis from nevirapine pure standard provided by Boehringer-Ingelheim (Ingelheim, Germany). In total, 6 kinds of tablets were assayed with 6 replicates per tablet, comprising a total of 36 chromatographic injections; no 2 tablets originated from the same lot.

Results. All nevirapine-containing products in this study were labeled as containing 200 mg of the drug. Nevirapine content and demographic data for the individual products are listed in the Table. The average nevirapine content among the tested preparations was 197.9 mg (coefficient of variation [CV], 3.4%). Average accuracy of nevirapine content in tested preparations versus labeled amounts was 99.0%.

Comment. To our knowledge, these data represent the first published account of drug content among generic antiretroviral preparations. Although our sample size is small, the products were representative of the companies that supply the majority of this drug. Given relatively stringent manufacturing standards, it is unlikely that there would be significant variability between lots. Further studies documenting bioequivalence between generic and proprietary antiretroviral medications are necessary.

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CORRECTION

Incorrect Numbers: The Original Contribution entitled "Change in the Quality of Care Delivered to Medicare Beneficiaries, 1998-1999 to 2000-2001" published in the January 15, 2003, issue of THE JOURNAL (2003;289:305-312) contained some incorrect numbers. The following **TABLE** amends Table 2 on page 307 of the original article by presenting the corrected values in the "Congestive Heart Failure" columns. In Table 3 on page 310, the value in the "Weighted average 2000-2001" row of the "Breast Cancer" column should read 60. In the same Table in the "Median state rate" rows of the "Lipid Profile" column, the values should read: 60 for the years "1998-1999," 74 for the years "2000-2001," and 76 for the "Weighted average 2000-2001."

None of the errors in Table 2 affected the baseline rankings or the national medians reported for the measures, which used the correct values when calculated, nor did they affect the summary values in Table 3, which also had been calculated using the correct values.

Table. Quality Indicator Averages (Absolute Change From Baseline) by State, 2000-2001

State	Left Ventricular Ejection Fraction	ACE Inhibitor
Alabama	70 (5)	58 (–4)
Alaska	69 (19)	70 (–21)
Nebraska	74 (15)	69 (3)
Nevada	82 (5)	62 (–10)
New Hampshire	82 (3)	77 (–7)
New Jersey	72 (0)	59 (–13)
New Mexico	58 (1)	70 (2)
New York	81 (6)	76 (6)
North Carolina	74 (3)	65 (–14)
North Dakota	45 (4)	68 (–8)

Abbreviation: ACE, angiotensin-converting enzyme.