CLINICAL REVIEW

Knowledge, Patterns of Care, and Outcomes of Care for Generalists and Specialists

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OBJECTIVE: **To critically evaluate the differences between generalist physicians and specialists in terms of knowledge, patterns of care, and clinical outcomes of care.**

METHODS: **English-language articles (January 1981 to January 1998) were identified through a MEDLINE search and examination of bibliographies of identified articles. Systematic evaluation of articles relevant to adult medicine that had a direct comparison between generalist physicians and specialists in terms of knowledge relative to widely accepted standards of care, patterns of care (including use of medications, ancillary services, procedures, and resource utilization), and outcomes of care was performed.**

MAIN RESULTS: **In many survey studies, specialists were reported to be more knowledgeable about conditions encompassed within their specialty. In terms of overall practice patterns, specialists practicing in their area of expertise were more likely to use medications associated with improved survival and to comply with routine health maintenance screening guidelines; they used more resources including diagnostic tests, procedures, and longer hospital stays. In the limited number of studies examining the care of patients with acute myocardial infarction, acute nonhemorrhagic stroke, and asthma, specialists had superior outcomes compared with generalists.**

CONCLUSIONS: **There is evidence in the literature suggesting differences between specialists and generalists in terms of knowledge, patterns of care, and clinical outcomes of care for a broad range of diseases. In published studies, specialists were generally more knowledgeable about their area of expertise and quicker to adopt new and effective treatments than generalists. More research is needed to examine whether these patterns of care translate into superior outcomes for patients. Further work is also needed to delineate the components of care for which generalists and specialists should be responsible, in order to provide the highest quality of care to patients while most effectively utilizing existing physician manpower.**

KEY WORDS: **specialties, medical; knowledge, attitudes, practice; prescription, drug; physician practice patterns; treatment, outcome.**

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The growth of managed care has led to increased efforts to restructure the physician workforce to include more primary care physicians and fewer specialists.[1–3] Primary care providers are increasingly asked to take on expanded responsibilities in the care of their patients in order to limit expensive consultations and associated tests and procedures. These changes have often been driven by financial concerns, as specialty care has been shown in some studies to be more expensive and utilize more resources.[4,5]

The effect of these changes on patient care is unknown.[6] However, there are concerns that when physicians practice outside their area of training, the relative quality of their performance declines.[7] These trends affect a significant portion of the population, as the number of Americans enrolled in HMOs increased two and a half times from 1987 to 1996.[8,9] Nearly 75% of insured working Americans are insured by some form of managed care.[10]

Although some specialty organizations have published recommendations on when specialty care should be utilized,[11,12] overall, substantial uncertainty remains about the relative benefits of specialist care versus that provided by primary care physicians in many clinical situations. A body of literature comparing generalists' and specialists' care is accumulating. The purpose of this review is to critically examine the numerous studies that have assessed differences in knowledge, patterns of care, and clinical outcomes of care between generalist and specialist physicians.

METHODS

To identify relevant journal articles for this study, we performed a MEDLINE search of English language articles published from January 1981 until January 1998. The Mesh heading "specialties, medical" was paired with "knowledge, attitudes, practice," "drug utilization," "prescription, drug," "preventive medicine," "primary prevention," "physician practice patterns," and "treatment,

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outcome," generating a total of 252 unique citations. Thirty-three more articles were identified after systematic review of the bibliographies of all articles identified through the MEDLINE search, for a total of 285 articles. Eighty-five percent of the articles (n = 243) were excluded because there was no direct comparison between generalist physicians and specialists in terms of *knowledge*, *patterns of care*, or *clinical outcomes of care* for the management of specified adult medical conditions.

We characterized studies as assessing *knowledge differences* between generalists and specialists when surveys were utilized to measure physicians' fund of knowledge relative to well-defined, widely accepted standards of care, including clinical guidelines published by national organizations or federal agencies.[13–19] We included studies as assessing *patterns of care* if the processes of care were measured in patient populations with direct comparisons of generalists with specialists. Articles based on physician surveys in which physicians indicated their own practice behavior in response to case scenarios or clinical vignettes were also included. Studies falling into this category included those examining the use of preventive practices (e.g., clinical breast examinations, Pap smears, mammograms, and tuberculin skin tests), as well as medication-prescribing patterns, and utilization of radiologic studies, laboratory tests, and procedures. Studies that assessed differences in resource utilization between generalists and specialists were also placed in this category; such studies examined overall costs for inpatient and outpatient care, as well as specific costs associated with the use of procedures and medications. Other resource utilization parameters were rates of hospitalization, number of office visits, length of hospital stay, and number of emergency department visits.

Studies examining differences in *clinical outcomes* between generalists and specialists assessed morbidity and mortality, as well as surrogate clinical outcome measures such as blood pressure, glycosylated hemoglobin levels, and forced expiratory volume in 1 second.

For the purpose of this review, generalist physicians were considered to include general internists, family practitioners, geriatricians, and general practitioners. In four articles, adolescent medicine physicians and pediatricians were included in the generalist physician category.[20–23] One article included physician assistants and nurse practitioners with the internists, family practitioners, and pediatricians in the defined generalist category.[23] Two articles defined generalists by the clinic site (e.g., primary care clinic).[20,21] One article did not specifically define which physicians were included in the generalist category.[24] All articles for this review had to focus on adult medicine. Studies relevant to adult medicine that included a small minority of adolescent patients among the participants were included.[20–24] Physicians characterized as specialists included internal medicine subspecialists, obstetricians and gynecologists, neurologists, general surgeons, orthopedic surgeons, and psychiatrists. Two articles defined the specialist by clinic site rather than by individual title (e.g., AIDS specialty clinic).[20,21]

RESULTS

The articles included in this review are listed by their clinical area of focus in Table 1.

Acute Myocardial Infarction

Six articles focused on how care for patients with acute myocardial infarction differs between generalists and specialists. Ayanian and colleagues surveyed 1,211 cardiologists, family practitioners, and internal medicine physicians in both New York and Texas about medications used for the treatment of acute myocardial infarction, assessing both physicians' knowledge and reported practice patterns.[25] The survey results were assessed relative to information from randomized clinical trials showing improved survival after acute myocardial infarction with thrombolytic therapy,[26,27] aspirin,[27,28] and β-blockers,[29–31] as well as lack of benefit from calcium channel blockers for patients with pulmonary congestion,[32–35] and prophylactic lidocaine.[36,37]

After controlling for physician and hospital characteristics, internists and family practitioners were found to believe less strongly in the benefits of the medications shown to improve survival in myocardial infarction and more strongly in the benefits of calcium channel blockers and prophylactic lidocaine relative to cardiologists. In terms of self-reported practice patterns, cardiologists were more likely than internists and family practitioners to state that they would prescribe thrombolytic agents, aspirin, and β-blockers, and less likely to report that they would use prophylactic lidocaine and calcium channel blockers for patients with acute myocardial infarction.

Hlatky and colleagues performed a national survey in 1987 of 1,065 physicians.[38] Eighty-six percent of cardiologists reported using thrombolytic therapy in the management of acute myocardial infarction, compared with only a third of surveyed family practitioners and general practitioners. Hlatky and coworkers also found that internists and family practitioners were significantly less likely to report using β-blockers and aspirin, as compared with cardiologists, in the acute hospital management of myocardial infarction.[39] There were no significant differences in reported use of postdischarge aspirin, but cardiologists were more likely to prescribe β-blockers.

Jollis and colleagues examined the treatment and outcome of Medicare patients who had suffered acute myocardial infarction and were under the care of cardiologists, internists, family practitioners, and general practitioners.[40] The investigators utilized information gathered from medical records on 8,241 patients hospitalized in four states over a 7-month period (June 1, 1992, through February 28, 1993), as well as analysis of insurance

claims for patients hospitalized for acute myocardial infarction in 1992 (n = 220,535). Those patients from the cohort of 8,241 who were treated by cardiologists were significantly more likely to receive thrombolytic therapy, β-blockers, aspirin, and noninvasive testing including stress testing, nuclear imaging, Holter monitoring, and echocardiography. In both groups of patients, those treated by cardiologists underwent substantially more invasive testing, such as coronary angiography and revascularization procedures.

Crude in-hospital, 30-day, and 1-year mortality rates in the cohort of 8,241 patients were lower for patients managed by cardiologists as compared with internists, family practitioners, and general practitioners. Patients admitted by cardiologists had a significantly better 1-year survival rate than those admitted by physicians in all the primary care specialties, even after adjustment for various patient and hospital characteristics. Outcome by specialty for the 220,535 patients identified through Medicare claims demonstrated similar benefits to having a cardiologist as the principal provider.

Ayanian and colleagues evaluated the treatment and outcomes of 1,620 Medicare beneficiaries treated for acute myocardial infarction during 1990 in 285 hospitals in Texas by cardiologists and generalist physicians (internists, family practitioners, and general practitioners) using clinical and administrative records.[41] Those under the care of cardiologists were more likely to be treated with thrombolytic therapy and aspirin during hospitalization as compared with patients cared for by generalists without a cardiology consult. After adjustment for patient characteristics and hospital characteristics, patients of cardiologists were more likely to undergo coronary angiiography and angioplasty. There were no significant differences in the adjusted 1-year mortality between patients treated by cardiologists and patients treated by generalist physicians without a cardiology consult.

Nash and colleagues collected statewide data on all 40,684 hospital admissions for acute myocardial infarction to Pennsylvania hospitals in 1993.[42] After adjustment for region, payer, hospital, and length of stay, patients cared for by cardiologists had a significantly lower adjusted mortality and hospital length of stay.

Other Cardiovascular Diseases

Friedmann and coworkers assessed physician knowledge using case simulations of three patients with typical presentations of hypercholesterolemia, isolated systolic hypertension, and chronic stable angina from left main coronary artery stenosis.[43] The authors surveyed 227 family physicians, general internists, and cardiologists to assess physician estimates of baseline cardiovascular risk and the outcomes of preventive therapy relative to the findings of published randomized clinical trials.[44–48] Cardiologists more accurately estimated baseline cardiovascular risk and risk reduction relating to the respective interventions, as compared with internists and family physicians.

Chin and coworkers examined the use of angiotensin-converting enzyme inhibitors for congestive heart failure by surveying 727 cardiologists, internists, and family physicians.[49] Cardiologists were significantly more likely to recommend using angiotensin-converting enzyme inhibitors for patients with reduced ejection fractions, which the medical literature clearly supports,[50,51] as compared with family practitioners, even after adjusting for physician and practice characteristics. Chin and colleagues also examined the use of angiotensin-converting enzyme inhibitors among patients with heart failure in 214 outpatients with moderately or severely decreased systolic function at an urban academic medical center who were cared for by cardiologists and generalists (general internists and geriatricians).[52] In this case, there were no differences in the use of angiotensin-converting enzyme inhibitors among patients cared for by cardiologists relative to generalists.

Stafford and coworkers utilized data from the 1991–1992 National Ambulatory Medical Care Survey to assess cholesterol management practices of U.S. physicians.[53] In adults without known hyperlipidemia, cardiologists were more likely to perform cholesterol testing and cholesterol counseling than family and general practitioners. In patients with known hyperlipidemia, cardiologists were more likely to prescribe lipid-lowering medications than family and general practitioners.

Young and coworkers surveyed 235 cardiologists and family practitioners employing four scenarios of patients with chest pain to assess the use of coronary arteriography.[54] Cardiologists had a higher threshold than family physicians for recommending coronary arteriography in all four clinical scenarios (i.e., cardiologists required a higher probability of coronary artery disease before recommending invasive testing). Glassman and colleagues used three case scenarios describing patients with uncomplicated syncope, nonanginal chest pain, and nonspecific electrocardiographic changes in a survey of 459 cardiologists and internists.[55] There was no consistent relation between provider type (cardiologist and internist) and the use of diagnostic testing across all of the case scenarios.

Greenwald and colleagues utilized data from the University of Southern California Medical Activities and Manpower Projects' physician surveys and from the United States Bureau of Health Professionals' Area Resource file including information on 125,000 patient encounters for ischemic heart disease and essential hypertension.[56] After adjustment for patient characteristics, physician characteristics, and practice characteristics, internists were found to order more laboratory studies and provide more medications, while cardiologists ordered more electrocardiograms.

Schreiber and coworkers compared 225 patients treated by internists with 665 patients cared for by cardiologists discharged with a diagnosis-related group diagnosis of unstable angina from a community hospital.[57] Patients

Table 1. Studies Comparing Generalists and Specialists in Terms of Knowledge, Patterns of Care, and Outcomes According to Disease State*

Author	Ref.	Subject	*n*	Data†	Topic	Subject of Comparison
Acute myocardial infarction						
Ayanian et al.	25	Physician	1,211	Self-report	Acute myocardial infarction	Knowledge, patterns of care
Hlatky et al.	38	Physician	1,065	Self-report	Acute myocardial infarction	Patterns of care
Hlatky et al.	39	Physician	1,065	Self-report	Acute myocardial infarction	Patterns of care
Jollis et al.	40	Patient	8,241	Medical record	Acute myocardial infarction	Patterns of care, outcomes
		Patient	220,535	Administrative	Acute myocardial infarction	Patterns of care, outcomes
Ayanian et al.	41	Patient	1,620	Administrative and medical record	Acute myocardial infarction	Patterns of care, outcomes
Nash et al.	42	Patient	40,684	Administrative	Acute myocardial infarction	Patterns of care, outcomes
Other cardiovascular diseases						
Friedmann et al.	43	Physician	227	Self-report	Hypercholesterolemia	Knowledge
		Physician	227	Self-report	Systolic hypertension	Knowledge
		Physician	227	Self-report	Coronary artery disease	Knowledge
Chin et al.	49	Physician	727	Self-report	Reduced ejection fraction	Patterns of care
Chin et al.	52	Patient	214	Medical record	Reduced ejection fraction	Patterns of care
Stafford et al.	53	Patient	56,215	Self-report	Hypercholesterolemia	Patterns of care
Young et al.	54	Physician	235	Self-report	Coronary artery disease	Patterns of care
Glassman et al.	55	Physician	459	Self-report	Synocope	Patterns of care
		Physician	459	Self-report	Nonanginal chest pain	Patterns of care
		Physician	459	Self-report	Nonspecific ECG changes	Patterns of care
Greenwald et al.	56	Physician	3,000	Self-report	Ischemic heart disease	Patterns of care
		Physician	3,000	Self-report	Hypertension	Patterns of care
Schreiber et al.	57	Patient	890	Medical record	Unstable angina	Patterns of care, outcomes
Greenfield et al.	58	Patient	532	Direct patient assessment	Hypertension	Patterns of care
		Patient	1,296	Direct patient assessment	Hypertension	Outcomes
Dermatologic diseases						
Clark and Rietschel	59	Physician	82	Self-report	Skin diseases	Knowledge, patterns of care
Endocrine diseases						
Greenfield et al.	58	Patient	170	Direct patient assessment	NIDDM	Patterns of care
		Patient	424	Direct patient assessment	NIDDM	Outcomes
Gastrointestinal diseases						
Fendrick et al.	60	Physician	1,119	Self-report	*Helicobactor pylori*	Knowledge
Mahajan et al.	61	Physician	310	Direct patient assessment	Gastrointestinal diseases	Patterns of care
Infectious diseases						
Markson et al.	20	Patient	2,433	Administrative	AIDS	Patterns of care
Mauskopf et al.	21	Patient	3,391	Administrative	AIDS	Patterns of care
Morin et al.	63	Physician	307	Self-report	Cryptosporidiosis	Knowledge

(Continued)

Table 1. Continued

Author	Ref.	Subject	*n*	Data†	Topic	Subject of Comparison
Neurologic diseases						
Mitchell et al.	64	Patient	32,357	Administrative	Acute stroke	Patterns of care, outcomes
Oncologic diseases						
McFall et al.	65	Physician	3,436	Self-report	Breast cancer	Knowledge
Wachtel and Mor	66	Patient	1,030	Self-report	Terminal diseases	Patterns of care
Preventive care						
Roetzheim et al.	67	Physician	530	Self-report	Mammography	Patterns of care
Lurie et al.	68	Physician	680	Administrative	Mammography	Patterns of care
			680	Administrative	Pap smears	Patterns of care
Taplin et al.	69	Physician	224	Self-report	Breast exams	Patterns of care
			224	Self-report	Mammography	Patterns of care
ACS	14	Physician	1,035	Self-report	Breast exams	Patterns of care
		Physician	1,035	Self-report	Mammography	Patterns of care
		Physician	1,035	Self-report	Pap smears	Patterns of care
		Physician	1,029	Self-report	Breast exams	Patterns of care
		Physician	1,029	Self-report	Mammography	Patterns of care
		Physician	1,029	Self-report	Pap smears	Patterns of care
Grisso et al.	70	Physician	298	Self-report	Estrogen replacement	Patterns of care
Braun and Weisner	22	Physician	549	Self-report	Tuberculin testing	Patterns of care
Dietrich and Goldberg	71	Physician	40	Medical record	Preventive medical care	Patterns of care
Psychiatric diseases						
Meredith et al.	73	Patient	361	Self-report and administrative	Depression	Patterns of care
Pulmonary diseases						
Strauss et al.	74	Patient	213	Administrative and direct patient assessment	COPD	Patterns of care, outcomes
Zeiger et al.	24	Patient	309	Self-report, medical record, and direct patient assessment	Asthma	Patterns of care, outcomes
Vollmer et al.	23	Patient	392	Self-report	Asthma	Patterns of care, outcomes
Rheumatologic and orthopedic diseases						
Bellamy et al.	76	Physician	189	Self-report	Gout	Patterns of care
Medellin et al.	77	Patient	73	Medical record	Gout	Patterns of care
Mazzuca et al.	78	Physician	276	Self-report	Osteoarthritis	Patterns of care
Mazzuca et al.	79	Patient	419	Direct patient assessment	Osteoarthritis	Patterns of care, outcomes
Walker et al.	80	Patient	57	Medical record	Acute monoarthritis	Patterns of care
Carey et al.	81	Patient	825	Self-report, medical record	Back pain	Patterns of care, outcomes
Shekelle et al.	82	Patient	479	Administrative	Back pain	Patterns of care

**ECG indicates electrocardiogram; NIDDM, non-insulin-dependent diabetes mellitus; ACS, American Cancer Society; COPD, chronic obstructive pulmonary disease.*

†*Data for the reviewed studies were obtained from self-report (questionnaires and surveys), medical records, administrative records, and direct patient assessment (meaning subjects were evaluated solely for the purpose of the study by the researchers involved).*

of cardiologists were more likely to be treated with aspirin and β-blockers as well as undergo coronary angiography and angioplasty during the hospitalization. There were no significant differences in length of stay, in-hospital charges, and clinical outcomes (death or new myocardial infarction during hospitalization) between patient groups.

Greenfield and colleagues, as part of the Medical Outcomes Study, investigated the management of patients with hypertension cared for by family practitioners, general internists, cardiologists, and endocrinologists in different health care systems (HMOs, fee-for-service organizations, and independent practice associations) in three major U.S. cities.[58] This observational study followed 532 patients with hypertension for 2 years. After 2 years, patients of endocrinologists and cardiologists were more likely to receive antihypertensive therapy, with no significant difference in

the number of office visits, change in systolic blood pressure, change in diastolic blood pressure, or change in physical function. There was no difference in the adjusted mortality rates among physician specialties after 7 years.

Dermatologic Diseases

Clark and Rietschel presented brief histories and slides of seven common and three uncommon dermatologic conditions to 41 dermatologists and 41 family practitioners.[59] The dermatologists diagnosed the correct dermatologic condition 98% of the time compared with 60% of the time for family practitioners.

Endocrine Diseases

Greenfield and colleagues, as part of the Medical Outcomes Study, investigated the management of patients with non-insulin-dependent diabetes mellitus (NIDDM) cared for by family practitioners, general internists, cardiologists, and endocrinologists in different health care systems as well as geographic locations.[58] In the 170 patients with NIDDM followed for 2 years, there were no significant differences between those cared for by internists, family practitioners, or endocrinologists in terms of receiving insulin therapy, frequency of blood sugar monitoring, frequency of foot examinations, or number of office visits. However, having an endocrinologist as a physician resulted in a decreased prevalence of foot ulcers compared with patients of internists, and significant improvement in foot infection healing rates, as compared with patients of family practitioners. For patients with NIDDM, change in physical function and adjusted mortality rates were not found to be different according to type of treating physician.

Gastrointestinal Diseases

Fendrick, Hirth, and Chernew surveyed a random national sample of 1,119 gastroenterologists, family practitioners, and general internists in 1994 to assess their knowledge about the role of *Helicobacter pylori* in the development of peptic ulcer disease and nonulcer dyspepsia.[60] Gastroenterologists were significantly more likely than generalist physicians to agree with the National Institutes of Health consensus panel[13] that the strength of the association between *H. pylori* and duodenal ulcer is strong and to believe there was moderate to strong evidence supporting the role of *H. pylori* in the development of gastric ulcers in the absence of nonsteroidal anti-inflammatory medication use.

Mahajan, Barthel, and Marshall compared the appropriateness of endoscopy referrals by primary care physicians (internists and family practitioners) and non–primary care physicians (internal medicine subspecialists and surgeons).[61] They prospectively tracked 310 consecutive patients scheduled for esophagogastroduodenoscopy and colonoscopy without prior evaluation by a gastroenterologist. The primary care physicians were significantly more likely than internal medicine subspecialists and surgeons to refer patients who met the American Society for Gastrointestinal Endoscopy indications[62] for esophagogastroduodenoscopy alone, for colonoscopy alone, and for the two procedures combined.

Infectious Diseases

Markson and colleagues studied the use of zidovudine therapy in 1,345 patients cared for by an AIDS specialty clinic or specialist physician and 1,088 patients cared for by primary care physicians or clinics.[20] The patients were all enrolled in the New York State Medicaid program for at least 6 months after AIDS diagnosis. After adjustment for differences in a range of patient characteristics, having a primary care physician or primary care clinic as the dominant provider for the majority of the patient's ambulatory care was found to significantly reduce the odds of receiving zidovudine therapy within 6 months after AIDS diagnosis relative to patients cared for by an AIDS specialty clinic or physician. When primary care patients had at least one consultation with an AIDS specialist, they were as likely to have filled a prescription for zidovudine as patients who received most of their care from an AIDS specialist.

Mauskopf and coworkers examined the use of the emergency department during the 6-month period after AIDS diagnosis by New York State Medicaid enrollees, of whom 1,675 were cared for by a primary care physician or clinic and 1,716 by an AIDS specialty clinic.[21] Patients with a primary care physician or primary care clinic as the dominant provider of care were found to be less likely to use emergency department services than patients whose dominant provider was an AIDS specialty clinic.

Morin and coworkers surveyed a stratified random sample of 307 Connecticut adult medicine physicians (93 gastroenterologists, 43 infectious disease specialists, 82 general and family practitioners, and 89 internists) to assess their knowledge about cryptosporidiosis.[63] Gastroenterologists and infectious disease specialists were more knowledgeable than general and family practitioners about the condition.

Neurologic Diseases

Mitchell and colleagues investigated the costs and outcomes of patients who had acute stroke using a random 20% sample of Medicare patients admitted for nonhemorrhagic cerebral infarction from January 1, 1991, to September 30, 1991.[64] The attending physician was a neurologist for 4,363 patients, both a neurologist and a primary care physician for 9,769 patients, an internist for 11,043 patients, and a family practitioner for 7,182 patients. Neurologists were significantly more likely than family practitioners and internists to order head CT

scans, brain MRIs, cerebral angiography, and noninvasive testing of the carotid arteries. Patients under the care of both a neurologist and a primary care physician had similar rates of CT scans, MRIs, and noninvasive cerebrovascular tests as those under the care of a neurologist alone. However, the rate of cerebral angiography for those with combined care was lower than that for those whose sole attending physician was a neurologist, but was higher than if the patient's sole physician had been a family practitioner or internist. The length of stay was greatest for patients who were cared for by a neurologist or had combined care by a primary care physician and neurologist.

Costs were calculated from all claims associated with the hospitalization and the period after acute care, up to 90 days after the admission and adjusted for geographic price differences. After adjustment for patient characteristics and hospital characteristics, the total cost per episode was significantly greater for neurology patients than for internal medicine patients and family practice patients. However, combined care was the most expensive. The 90-day mortality rates, adjusted for patient characteristics and hospital characteristics, were significantly lower for neurology patients than for family practice patients, internal medicine patients, and patients cared for by the combination of a neurologist and an internist.

Oncologic Diseases

Two studies explored how oncologic patterns of care differ depending on physician specialty. McFall and colleagues surveyed 3,436 family practitioners, internists, gynecologists, and general surgeons using clinical scenarios of women with stage I and stage II breast cancer,[65] in order to determine how clinical judgments were made relative to the 1985 and 1990 National Institutes of Health consensus conference recommendations.[17,18] After adjustment for differences in practice characteristics, surgeons were more likely to make judgments consistent with the consensus conference recommendations than the family practitioners.

Wachtel and Mor compared utilization of services by 576 patients with terminal cancer under the care of general internists, general practitioners, and family practitioners, with the utilization by 454 patients under the care of hematologist-oncologists.[66] The data were adjusted for the setting (hospice and nonhospice) and for physician characteristics. There were no significant differences in the use of x-rays, oxygen, and intravenous therapy between generalists and hematologist-oncologists. However, hematologist-oncologists were more likely to order blood tests.

Preventive Care

Four articles examined specialty differences regarding health screening and prevention measures in women (i.e., mammography, breast examinations, and Pap smears). Roetzheim and coworkers examined physician compliance with the American Cancer Society's 1989 guidelines for mammography,[14] using survey responses from 87 general practitioners, 153 internists, 198 family practitioners, and 92 obstetricians and gynecologists in the greater Tampa Bay area.[67] Significantly more obstetricians and gynecologists reported compliance with the mammography guidelines than family practitioners, internists, and general practitioners.

Lurie and colleagues examined administrative data on mammography and Pap tests for women enrolled in a single health plan in Minneapolis and St. Paul, Minn, under the care of 130 obstetricians and gynecologists and 550 internists and family practitioners.[68] After adjustment for patient age, physician age, and physician gender, the obstetricians and gynecologists were substantially more likely to screen patients with Pap smears and mammography than the internists and family practitioners.

Taplin and coworkers conducted a survey of 151 general and family practitioners, 44 internists, and 29 obstetricians and gynecologists.[69] Significantly more obstetricians and gynecologists reported performing clinical breast examinations in their female patients aged 50 to 75 years and ordering screening mammography, as compared with general and family practitioners and internists.

The American Cancer Society conducted a national survey of physicians in 1984 and 1989 to determine the percentage who followed its recommended guidelines for cancer detection including physical breast examinations, mammography, and Pap smears.[14] Telephone interviews were conducted with 1,035 physicians in 1984 and 1,029 physicians in 1989 (general and family practitioners, internists, and obstetricians and gynecologists). In both surveys, obstetricians and gynecologists were significantly more likely to report compliance with the American Cancer Society guidelines than general family practitioners and internists, except for mammography-ordering practices in 1989.

Grisso, Baum, and Turner surveyed 119 gynecologists, 116 internists, and 63 cardiopulmonary specialists regarding their use of estrogen replacement therapy to prevent osteoporosis.[70] Gynecologists reported that 45% of their postmenopausal patients received estrogen replacement therapy to prevent osteoporosis, in contrast to only 15% and 14% of postmenopausal women in the practices of general internists and cardiopulmonary specialists, respectively.

Braun and Wiesner surveyed the use of tuberculin skin testing among 198 primary care physicians, 95 surgeons, 215 medical and pediatric specialists, and 41 obstetricians and gynecologists to determine physicians' practice patterns relating to screening for and prevention of tuberculosis.[22] Primary care physicians were significantly more likely to report ordering at least one skin test in the previous year than the other physician groups.

Dietrich and Goldberg compared 20 generalist physicians (family practitioners and general internists) with 20

internal medicine subspecialists practicing in Santa Clara and San Mateo Counties, Calif,[71] by auditing charts of adult primary care patients for compliance with recommendations of the Canadian Task Force on the Periodic Health Examination.[72] There were no significant differences between the two physician groups.

Psychiatric Diseases

Meredith, Wells, and Camp, as part of the Medical Outcomes Study, examined the management of depression by 91 family physicians, 194 internists, and 76 psychiatrists.[73] Patients identified by their clinician as depressed were significantly more likely to receive prescriptions for antidepressant medications and counseling if the physician caring for their depression was a psychiatrist rather than an internist or family practitioner.

Pulmonary Diseases

Three articles, one focusing on chronic obstructive pulmonary disease and the other two on asthma, explored how different specialists care for pulmonary patients and the resulting outcomes. Strauss and coworkers examined the costs, resource utilization, and outcomes in 213 patients with chronic obstructive pulmonary disease cared for by 36 pulmonologists (135 patients), 33 internists (46 patients), and 27 family practitioners (32 patients).[74] After adjustment for patient characteristics, there were no significant differences in the outpatient costs, total costs, hospital length of stay, change in pulmonary function (as assessed by forced expiratory volume in 1 second) and mortality between patient groups.

Zeiger and colleagues studied whether care delivered by an allergist would decrease relapses in asthma patients who were enrolled in the San Diego Kaiser Health Plan.[24] Patients treated by allergists (n = 149) were more likely to be better or much better after 6 months of treatment as compared with those receiving generalist care (n = 160). The patients treated by allergists were also less likely to require emergency department evaluation for asthma relapses during a 6-month follow-up period, as compared with those treated by generalists.

Vollmer and colleagues performed a cross-sectional study of asthma patients in a staff-model HMO comparing 181 patients cared for by allergists with 211 patients cared for by generalists (internists, family practitioners, pediatricians, physician assistants, and nurse practitioners).[23] Patients treated by allergists were more likely than patients treated by generalists to be evaluated in the outpatient clinic rather than the emergency department or urgent care clinic for acute exacerbations. Patients of allergists also scored higher in various quality-of-life domains: physical functioning, emotional functioning, bodily pain, and general health.[75]

Rheumatologic and Orthopedic Diseases

Bellamy and coworkers surveyed 71 rheumatologists and 118 family physicians regarding their medical management of gout.[76] Rheumatologists were more than twice as likely to measure 24-hour urinary excretion of uric acid and were also more likely to appropriately coadminister either colchicine or a nonsteroidal anti-inflammatory drug when initiating urate-lowering therapy to prevent a gout attack. Similarly, Medellin et al. reviewed pharmacy records of patients treated with colchicine, allopurinol, probenecid, or sulfinpyrazone, to identify 40 patients treated for presumed gout by generalist physicians.[77] Thirty-three gout patients followed by rheumatologists during the same period constituted the comparison group. Rheumatologists were more likely to obtain a 24-hour urine sample to assess uric acid excretion and provide prophylactic treatment with colchicine or nonsteroidal anti-inflammatory agents when starting therapy to lower uric acid levels than generalists.

Mazzuca and colleagues surveyed 150 primary care physicians and 126 rheumatologists regarding treatment for hip osteoarthritis using three case scenarios of patients with osteoarthritis.[78] In one of three scenarios, the monthly total costs of drug therapy proposed by rheumatologists were higher than those proposed by primary care physicians. Referral to physical therapy was suggested by 34% of rheumatologists as compared with 14% of primary care physicians.

In an observational study, Mazzuca and coworkers examined the care provided to 419 patients with symptoms of knee osteoarthritis followed by family practitioners, internists, and rheumatologists.[79] In contrast to patients of internists and family practitioners, patients of rheumatologists were more likely to report office-based instruction concerning the performance of quadriceps exercises, range-of-motion exercises, instructions on protecting their knees from mechanical stress, and formal self-care education. There were no significant differences between the patients of internists, family practitioners, and rheumatologists in terms of knee pain or physical function after 6 months of treatment.

In the United Kingdom, Walker and coworkers compared the evaluation of acute monoarthritis in 21 patients cared for by general practitioners with that in 36 patients under the care of rheumatologists.[80] None of the patients cared for by general practitioners had joint aspiration, and all were diagnosed with gout. Of the patients cared for by rheumatologists, only nine were diagnosed with gout, of whom six were aspirated.

Carey and colleagues examined the management of acute low back pain by primary care physicians and orthopedic surgeons in North Carolina.[81] There were 644 patients under the care of primary care physicians and 181 patients cared for by orthopedic surgeons. The estimated outpatient charges were calculated and adjusted for baseline functional status, presence of sciatica, duration of

pain, income, and worker's compensation. Patients of orthopedists had the higher unadjusted and adjusted costs and received more radiographs of the spine, as well as CT scans and MRIs, as compared with those cared for by primary care physicians. Return to baseline function was the outcome measure of interest; the probability of recovery was not different at 4, 8, 12, and 24 weeks across provider types.

Shekelle and associates compared the costs of an episode of back pain treated by different types of providers in the RAND Health Insurance Experiment.[82] This population-based, observational trial tracked the use of medical services and health status of families randomly selected from four states over periods of 3 or 5 years in the 1970s. Care was provided by general practitioners in 262 episodes of back pain, internists in 60 episodes, and orthopedic surgeons in 85 episodes. Orthopedic surgeons had significantly higher mean total cost per episode of back pain care than general practitioners ($531 vs $281).

DISCUSSION

In our review, we assessed the existing literature comparing generalist to specialist physicians across three domains: knowledge, practice patterns, and clinical outcomes of care. The findings of these studies suggest that specialists are more knowledgeable about the management of selected conditions including acute myocardial infarction,[25] hypertension,[43] hypercholesterolemia,[43] coronary artery disease,[43] *H. pylori* infection,[60] and common dermatologic conditions.[59] Specialists practicing in their respective areas of expertise were more likely to use medications associated with improved survival in their patients,[20,25,38–40,41,49,57] as well as to comply with routine health maintenance screening guidelines.[14,67–69] However, specialists were also more likely to use more resources, including diagnostic tests,[40,57,64] procedures,[40] and longer hospital stays,[64] as compared with generalist physicians. In a few studies examining the care of acute myocardial infarction,[40,42] acute nonhemorrhagic stroke,[64] and asthma,[23,24] care by specialists appeared to be associated with superior clinical outcomes, as compared with care by generalist physicians. However, differences between specialists and generalists in regard to outcomes of care were not observed in the management of hypertension,[58] NIDDM,[58] unstable angina,[57] chronic obstructive pulmonary disease,[74] and low back pain.[81]

Ayanian and colleagues have suggested that a superior knowledge base in selected clinical areas for the specialist, relative to the generalist, is understandable given the volume of new medical information that continually needs to be assimilated.[25] Specialists have the benefit of treating a narrower range of clinical problems,[20,25] can devote more time to continuing education relevant to the treatment of such conditions,[40] and may have greater access to new information than generalists.[20] For example, it has been noted that most published guidelines for the treatment of myocardial infarction have appeared in journals that target cardiologists.[19,25,83] Specialists may also have more contact with leading experts in the field (e.g., at national meetings), who may be persuasive in encouraging earlier adoption of effective treatments or management approaches.[20]

Several authors have suggested reasons to explain the differences in treatment patterns observed between specialists and generalists. Fendrick and colleagues have postulated that generalist physicians might have a "wait and see" attitude,[60] possibly from a greater concern about therapeutic complications,[20] or greater caution in accepting new data or changing established patterns of treatment.[25] Conversely, specialists may be more convinced by new medical information than generalists or adopt emerging technologies more aggressively regardless of their clinical usefulness.[60] Patients themselves may choose to go to specialists because they are interested in the availability of new therapies and diagnostic tests and may be more likely to request these services from their provider than patients who choose to go to generalists.[20]

A longer lag time in the adoption of new effective therapies by generalists than by specialists has been described for treatments related to acute myocardial infarction,[38] peptic ulcer disease,[60] and AIDS.[20] Hlatky and coworkers[38] found that cardiologists adopted thrombolytic therapy, as a conventional therapy,[26,27] earlier than generalists. The slower adoption of *H. pylori* eradication therapy by primary care providers was reported by Fendrick and colleagues.[60] Similar findings have been observed in regard to the use of zidovudine in AIDS patients. Markson and colleagues found at least a 3-year lag time before patients receiving care in primary care clinics received zidovudine therapy at the same rate as patients cared for by AIDS specialists.[20] These examples of delay in the adoption of new, effective therapies by generalists relative to specialists suggest that this pattern may extend across all areas of medical practice.

Increased use of resources in the care of similar patients by specialists compared with generalists was reported in the management of acute myocardial infarction,[40] unstable angina,[57] hypertension,[58] low back pain,[81,82] and acute stroke.[64] Yet, the increased use of resources did not consistently result in improved clinical outcomes. For example, in the management of low back pain, there was no difference between patients of specialists and patients of generalists in the time to recovery, even though orthopedists saw their patients more often, ordered more radiologic tests, and generated higher health care costs.[81] Greenfield and coworkers in the Medical Outcomes Study reported higher resource utilization by specialists (endocrinologists and cardiologists) than by generalists (family practitioners and internists) without significant differences in the clinical outcome of interest, blood pressure.[58] More data are needed to determine the clinical situations and subsets of patients in which increased use of resources

results in superior outcomes in order to optimize care by generalists and control health care costs.

For the few studies examining the care of patients with acute myocardial infarction,[40,42] acute nonhemmorrhagic stroke,[64] and asthma,[23,24] care by a specialist appeared to be associated with improved outcomes as compared with care by a generalist. Jollis and coworkers hypothesized that cardiologists have a narrower focus in the diseases they treat, and thus are likely be more familiar with the diagnosis and management of acute myocardial infarction complications, thereby achieving better outcomes.[40] Factors other than physician specialty may contribute to the lower mortality rates among patients admitted by cardiologists. These would include admission to a hospital that cares for large numbers of patients with acute myocardial infarction, the presence of emergency department physicians who are likely to recognize acute myocardial infarction and initiate early treatment, and on-site availability of coronary angioplasty or bypass surgery for the management of complications.[40] Ayanian and coworkers found that patients admitted to hospitals offering coronary angioplasty and bypass surgery had lower adjusted 1-year mortality rates than patients admitted to other hospitals.[41]

In the care of stroke patients, Mitchell and coworkers postulated that factors associated with neurologist care, such as specialized nursing staff and access to assistance by other health care professionals including physical therapists and occupational therapists, may have contributed to the reduced mortality rate in patients cared for by neurologists.[64] Medical units dedicated to the treatment of acute stroke patients, using an organized team of health care providers (e.g., primary care physician, social worker, physiotherapist, occupational therapist, speech therapist, neuropsychologist, neurologist, and nurses), have been associated with better outcomes in stroke patients.[84,85] Although asthma patients under the care of specialists have been shown to have fewer emergency department visits and improved quality of life,[23,24] possible explanations include more time available for evaluation by the specialist and a nursing staff that has greater knowledge of asthma pathophysiology and more experience in managing asthma patients.

Although the reviewed literature suggests that specialists are more knowledgeable about specific medical conditions, use more resources, and may achieve better clinical outcomes, there are methodologic limitations that should be considered in the interpretation of study findings. This review was limited to observational studies; these research designs have the risk of bias and confounding. Studies based on survey data in which physicians self-report how they practice or respond to clinical vignettes may not accurately reflect actual practice.[86] Response rates to surveys of physicians were variable across studies, which could affect the validity of the results.

Methodologic standards to guide the interpretation of results of studies that compare generalist care and specialist care have been proposed by Solomon and coworkers.[87] Their recommendations include the need for more detailed descriptions of the characteristics of the practitioners, patients, and outcomes as well as determining whether the power of the study is adequate to detect meaningful differences. In some of the studies included in this review,[77,80] small numbers of participants may have reduced the statistical power of the study. Most studies utilized the patient as the unit of analysis, when a physician or practice-level analysis may have been more appropriate. For example, in the article by Schreiber and coworkers,[57] the unit of analysis was the patient. However, the study population was derived from a single community hospital in which the cardiology patients may have been cared for by a very small number of cardiologists. The patterns of care in these patients may reflect the practice of only a few physicians.

Because the majority of these studies based comparisons of the care provided by generalists and specialists solely on short-term outcomes, the long-term outcomes of care remain uncertain.[88] For some diseases, like NIDDM, long-term outcomes are clinically more important. The Medical Outcomes Study examined 2-year and 4-year outcomes in non-insulin-dependent diabetics,[58] which may have been too short a time to find meaningful differences,[89] given that the Diabetes Control and Complication Trial required 5 to 7 years to demonstrate differences in the risk of disease complications.[90]

Some of the studies have limited generalizability in that the study population was derived from a single site; patient characteristics and physician practice patterns may differ depending on geographic location.[91] Studies in which participants were drawn from a national sample more often demonstrated that specialists had provided more appropriate treatment, used more resources, and cared for patients whose outcomes were superior to those under the care of generalists.

The definitions of generalist and specialist physicians differed between studies. Combining internists and family practitioners into the generalist category may not be appropriate in some cases, and this may reduce the differences found between the care provided by generalists and specialists.[65] The patients of generalists and specialists in some articles differed in terms of the presumed etiology of the medical diagnosis,[57] the severity of the disease of interest,[23,79] and the severity of comorbid conditions.[40,41] In some studies, the patients cared for by generalists had more comorbid conditions and greater predicted mortality,[40] while this situation was reversed in others.[58] Further assessment of the severity of illness in study populations would help clarify when specialty care is needed, as specialist care may be more likely to benefit the sickest patients. Some studies made no case-mix adjustments for population differences. When an effort to adjust for differences is made, the adequacy of the adjustment often remains uncertain. Finally, publication bias may have resulted in inappropriate conclusions regarding the care provided by generalists and specialists.

Collaborative care between specialists and generalists should be further explored.[88,92] Hiss and Greenfield have proposed a comanagement system approach to care whereby the primary care physician would be responsible for the ongoing comprehensive care of patients, and specialists would assist during illness when their input would have a positive impact.[92] However, some studies have associated collaborative care with greater resource utilization without an improvement in clinical outcomes.[41,64] Potentially, the health care provided by generalists could be improved by limited consultation with specialists in certain clinical situations as demonstrated by Markson and coworkers.[20] This could optimize health care without greatly increasing costs. Further work is needed to assess how to organize the health care system so that care provided by generalists and specialists is well coordinated, results in superior outcomes, and is cost-effective. The studies examined in this article focused on well-defined, narrowly focused diagnoses. In clinical practice, patients often have several concomitant medical conditions. The challenge for further research is to translate the available evidence into systems of care that allow generalists and specialists to act both independently and collaboratively, to best meet the needs of patients.

REFERENCES

1. Weiner JP. Forecasting the effects of health reform on US physician workforce requirement: evidence from HMO staffing patterns. JAMA. 1994;272:222–30.
2. Cooper RA. Seeking a balanced physician workforce for the 21st century. JAMA. 1994;272:680–7.
3. DeMaria AN, Lee TH, Leon DF, et al. Effect of managed care on cardiovascular specialists: involvement, attitudes and practice adaptations. J Am Coll Cardiol. 1996;28:1884–95.
4. Kravitz RL, Greenfield S. Variations in resource utilization among medical specialties and systems of care. Annu Rev Public Health. 1995;16:431–45.
5. Greenfield S, Nelson EC, Zubkoff M, et al. Variations in resource utilization among medical specialties and systems of care: results from the Medical Outcomes Study. JAMA. 1992;267:1624–30.
6. Kassirer JP. Access to specialty care. N Engl J Med. 1994;331: 1151–3.
7. Rhee SO, Luke RD, Lyons TF, Payne BC. Domain of practice and the quality of physician performance. Med Care. 1981;19:14–23.
8. Hoechst Marion Roussel Managed Care Digest Series. Kansas City, Mo: Hoechst Marion Roussel; 1997.
9. Group Health Association of America. Patterns in HMO Enrollment. Washington, DC: Group Health Association of America, June 1995.
10. Jensen GA, Morrisey MA, Gaffney S, Liston DK. The new dominance of managed care: insurance trends in the 1990s. Health Aff. 1997;16:125–36.
11. Recommendations of the American Society of Internal Medicine. Patient Access to Internist-Subspecialists in Gatekeeper Health Plans; ASIM, Washington, DC. August 1995.
12. Committee of the American College of Rheumatology Council on Health Care Research. Role of specialty care for chronic diseases: a report from an Ad Hoc committee of the American College of Rheumatology. Mayo Clin Proc. 1996;71:1179–81.
13. NIH Consensus Development Panel on Helicobacter pylori in Peptic Ulcer Disease. *Helicobacter pylori* in peptic ulcer disease. JAMA. 1994;272:65–9.
14. American Cancer Society. 1989 survey of physicians' attitudes and practices in early cancer detection. CA Cancer J Clin. 1990;40:77–101.
15. National Institutes of Health. The treatment of primary breast cancer: management of local disease. Consensus Development Conference, Bethesda, Md, June 5, 1979.
16. National Institutes of Health. Adjuvant chemotherapy for breast cancer. Consensus Development Conference, Bethesda, Md, July 14–16, 1980.
17. National Institutes of Health. Adjuvant chemotherapy for breast cancer. Consensus Development Conference, Bethesda, Md, September 9–11, 1985.
18. National Institutes of Health. Treatment of early-stage breast cancer. Consensus Development Conference, Bethesda, Md, June 18–21, 1990.
19. Gunnar RM, Bourdillon PD, Dixon DW, et al. ACC/AHA guidelines for the early management of patients with acute myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures. Circulation. 1990;82: 664–707.
20. Markson LE, Cosler LE, Turner BJ. Implications of generalists' slow adoption of zidovudine in clinical practice. Arch Intern Med. 1994;154:1497–504.
21. Mauskopf J, Turner BJ, Markson LE, Houchens RL, Fanning TR, McKee L. Patterns of ambulatory care for AIDS patients, and association with emergency room use. Health Serv Res. 1994;29: 489–510.
22. Braun MM, Weisner PJ. Tuberculosis prevention practices and perspectives of physicians in DeKalb County, Ga. Public Health Rep. 1994;109:259–65.
23. Vollmer WM, O'Hollaren M, Ettinger KM, et al. Specialty differences in the management of asthma: a cross-sectional assessment of allergists' patients and generalists' patients in a large HMO. Arch Intern Med. 1997;157:1201–8.
24. Zeiger RS, Heller S, Mellon MH, Wald J, Falkoff R, Schatz M. Facilitated referral to asthma specialist reduces relapses in asthma emergency room visits. J Allergy Clin Immunol. 1991;87:1160–8.
25. Ayanian JZ, Hauptman PJ, Guadagnoli E, Antman EM, Pashos CL, McNeil BJ. Knowledge and practices of generalist and specialist physicians regarding drug therapy for acute myocardial infarction. N Engl J Med. 1994;331:1136–42.
26. Gruppo Italiano per lo Studio della Streptochinasi nell'Infarto Miocardico (GISSI). Effectiveness of intravenous thrombolytic treatment in acute myocardial infarction. Lancet. 1986;1:397–402.
27. ISIS-2 (Second International Study of Infarct Survival) Collaborative Group. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. Lancet. 1988;2:349–60.
28. Antiplatelet Trialists' Collaboration. Secondary prevention of vascular disease by prolonged antiplatelet treatment. BMJ. 1988;296: 320–31.
29. The Norwegian Multicenter Study Group. Timolol-induced reduction in mortality and reinfarction in patients surviving acute myocardial infarction. N Engl J Med. 1981;304:801–7.
30. β-Blocker Heart Attack Trial Research Group. A randomized trial of propranolol in patients with acute myocardial infarction. I: mortality results. JAMA. 1982;247:1707–14.
31. Yusuf S, Peto R, Lewis J, Collins R, Sleight P. Beta blockade during and after myocardial infarction: an overview of the randomized trials. Prog Cardiovasc Dis. 1985;27:335–71.
32. The Danish Study Group on Verapamil in Myocardial Infarction. Verapamil in acute myocardial infarction. Eur Heart J. 1984;5: 516–28.
33. The Israeli Sprint Study Group. Secondary Prevention Reinfarction Israeli Nifedipine Trial (SPRINT): a randomized intervention trial of nifedipine in patients with acute myocardial infarction. Eur Heart J. 1988;9:354–64.

34. The Multicenter Diltiazem Postinfarction Trial Research Group. The effect of diltiazem on mortality and reinfarction after myocardial infarction. N Engl J Med. 1988;319:385–92.
35. Held PH, Yusuf S, Furberg CD. Calcium channel blockers in acute myocardial infarction and unstable angina: an overview. BMJ. 1989;299:1187–92.
36. MacMahon S, Collins R, Peto R, Koster RW, Yusuf S. Effects of prophylactic lidocaine in suspected acute myocardial infarction: an overview of results from the randomized, controlled trials. JAMA. 1988;260:1910–6.
37. Hine LK, Laird N, Hewitt P, Chalmers TC. Meta-analytic evidence against prophylactic use of lidocaine in acute myocardial infarction. Arch Intern Med. 1989;149:2694–8.
38. Hlatky MA, Cotugno H, O'Connor C, Mark DB, Pryor DB, Califf RM. Adoption of thrombolytic therapy in the management of acute myocardial infarction. Am J Cardiol. 1988;61:510–4.
39. Hlatky MA, Cotugno HE, Mark DB, O'Connor C, Califf RM, Pryor DB. Trends in physician management of uncomplicated acute myocardial infarction, 1970 to 1987. Am J Cardiol. 1988;61:515–8.
40. Jollis JG, DeLong ER, Peterson ED, et al. Outcome of acute myocardial infarction according to the specialty of the admitting physician. N Engl J Med. 1996;335:1880–7.
41. Ayanian JZ, Guadagnoli E, McNeil BJ, Cleary PD. Treatment and outcomes of acute myocardial infarction among patients of cardiologists and generalist physicians. Arch Intern Med. 1997;157: 2570–6.
42. Nash IS, Nash DB, Fuster V. Do cardiologists do it better? J Am Coll Cardiol. 1997;29:475–8.
43. Friedmann PD, Brett AS, Mayo-Smith MF. Differences in generalists' and cardiologists' perceptions of cardiovascular risk and the outcomes of preventive therapy in cardiovascular disease. Ann Intern Med. 1996;124:414–21.
44. Lipid Research Clinics Program. The lipid research clinics coronary primary prevention trial results. I: reduction in incidence of coronary heart disease. JAMA. 1984;251:351–64.
45. Frick MH, Elo O, Haapa K, et al. Helsinki Heart Study: primary-prevention trial with gemfibrizol in middle-aged men with dyslipidemia. Safety of treatment, changes in risk factors, and incidence of coronary heart disease. N Engl J Med. 1987;317:1237–45.
46. SHEP Cooperative Research Group. Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension. Final results of the systolic hypertension in the elderly program (SHEP). JAMA. 1991;265:3255–64.
47. Takaro T, Peduzzi P, Detre KM, et al. Survival in subgroups of patients with left main coronary artery disease. Veterans Administration Cooperative Study of Surgery for Coronary Artery Occlusive Disease. Circulation. 1982;66:14–22.
48. Chaitman BR, Fisher LD, Bourassa MG, et al. Effect of coronary bypass surgery on survival patterns in subsets of patients with left main coronary artery disease: report of the Collaborative Study in Coronary Artery Surgery (CASS). Am J Cardiol. 1981;48: 765–77.
49. Chin MH, Friedmann PD, Cassel CK, Lang RM. Differences in generalist and specialist physicians' knowledge and use of angiotensin-converting enzyme inhibitors for congestive heart failure. J Gen Intern Med. 1997;12:523–30.
50. The SOLVD Investigators. Effect of enalapril on survival in patients with reduced left ventricular ejection fractions and congestive heart failure. N Engl J Med. 1991;325:293–302.
51. The SOLVD Investigators. Effect of enalapril on mortality and the development of heart failure in asymptomatic patients with reduced left ventricular ejection fractions. N Engl J Med. 1992;327: 685–91.
52. Chin MH, Wang JC, Zhang JX, Lang RM. Utilization and dosing of angiotensin-converting enzyme inhibitors for heart failure: effect of physician specialty and patient characteristics. J Gen Intern Med. 1997;12:563–6.
53. Stafford RS, Blumenthal D, Pasternak RC. Variations in cholesterol management practices of US physicians. J Am Coll Cardiol. 1997;29:139–46.
54. Young MJ, Fried LS, Eisenberg J, Hershey J, Williams S. Do cardiologists have higher thresholds for recommending coronary arteriography than family physicians? Health Serv Res. 1987;22:623–35.
55. Glassman PA, Kravitz RL, Petersen LP, Rolph JE. Differences in clinical decision making between internists and cardiologists. Arch Intern Med. 1997;157:506–12.
56. Greenwald HP, Peterson ML, Garrison LP, et al. Interspecialty variation in office-based care. Med Care. 1984;22:14–29.
57. Schreiber TL, Elkhatib A, Grines CL, O'Neill WW. Cardiologist versus internist management of patients with unstable angina: treatment patterns and outcomes. J Am Coll Cardiol. 1995;26:577–82.
58. Greenfield S, Rogers W, Mangotich M, Carney MF, Tarlov AR. Outcomes of patients with hypertension and non-insulin-dependent diabetes mellitus treated by different systems and specialties. Results from the Medical Outcomes Study. JAMA. 1995;274: 1436–44.
59. Clark RA, Rietschel RL. The cost of initiating appropriate therapy for skin disease: a comparison of dermatologists and family physicians. J Am Acad Dermatol. 1983;9:787–96.
60. Fendrick AM, Hirth RA, Chernew ME. Differences between generalist and specialist physicians regarding *Helicobacter pylori* and peptic ulcer disease. Am J Gastroenterol. 1996;91:1544–8.
61. Mahajan RJ, Barthel JS, Marshall JB. Appropriateness of referrals for open-access endoscopy: how do physicians in different medical specialties do? Arch Intern Med. 1996;156:2065–9.
62. American Society for Gastrointestinal Endoscopy. Appropriate Use of Gastrointestinal Endoscopy. Manchester, Mass: American Society for Gastrointestinal Endoscopy; 1992.
63. Morin CA, Roberts CL, Mshar PA, Addiss DG, Hadler JL. What do physicians know about cryptosporidiosis? A survey of Connecticut physicians. Arch Intern Med. 1997;157:1017–22.
64. Mitchell JB, Ballard DJ, Whisnant JP, Ammering CJ, Samsa GP, Matchar DB. What role do neurologists play in determining the costs and outcomes of stroke patients? Stroke. 1996;27:1937–43.
65. McFall SL, Warnecke RB, Kaluzny AD, Aitken M, Ford L. Physician and practice characteristics associated with judgements about breast cancer treatment. Med Care. 1993;32:106–17.
66. Wachtel TJ, Mor V. Physicians' use of health resources for terminal cancer patients: clinical setting versus physician specialty. South Med J. 1987;80:1120–4.
67. Roetzheim RG, Van Durme DJ, Brownlee HJ, Herold AH, Pamies RJ, Woodard L. Compliance with screening mammography: survey of primary care physicians. J Fla Med Assoc. 1991;78:426–9.
68. Lurie N, Slater J, McGovern P, Ekstrum J, Quam L, Margolis K. Preventive care for women. Does the sex of the physician matter? N Engl J Med. 1993;329:478–82.
69. Taplin SH, Taylor V, Montano D, Chinn R, Urban N. Specialty differences and the ordering of screening mammography by primary care physicians. J Am Board Fam Pract. 1994;7:375–86.
70. Grisso JA, Baum CR, Turner BJ. What do physicians in practice do to prevent osteoporosis? J Bone Miner Res. 1990;5:213–9.
71. Dietrich AJ, Goldberg H. Preventive content of adult primary care: do generalists and specialists differ? Am J Public Health. 1984; 74:223–7.
72. Minister of Supply and Services Canada. Periodic Health Examination Report of a Task Force to the Conference of Deputy Ministers of Health, Ottawa, Canada, 1980.
73. Meredith LS, Wells KB, Camp P. Clinical specialty and treatment style for depressed outpatients with and without medical comorbidities. Arch Fam Med. 1994;3:1065–72.
74. Strauss MJ, Conrad D, LoGerfo JP, Hudson LD, Bergner M. Cost and outcome of care for patients with chronic obstructive lung disease. Med Care. 1986;24:915–24.
75. Ware JE, Sherbourne CA, Davies AR. A Short-Form General Health Survey. Santa Monica, Calif: RAND; 1988. Publication P-7444.
76. Bellamy N, Gilbert JF, Brooks PM, Emmerson BT, Campbell J. A

survey of current prescribing practices of antiinflammatory and urate lowering drugs in gouty arthritis in the province of Ontario. J Rheumatol. 1988;15:1841–7.
77. Medellin MV, Erickson AR, Enzenauer RJ. Variability of treatment for gouty arthritis between rheumatologists and primary care physicians. JCR J Clin Rheumatol. 1997;3:24–7.
78. Mazzuca SA, Brandt KD, Katz BP, Li W, Stewart KD. Therapeutic strategies distinguish community based primary care physicians from rheumatologists in the management of osteoarthritis. J Rheumatol. 1993;20:80–6.
79. Mazzuca SA, Brandt KD, Katz BP, et al. Comparison of general internists, family physicians, and rheumatologists managing patients with symptoms of osteoarthritis of the knee. Arthritis Care Res. 1997;10:289–99.
80. Walker DJ, Young I, Hassey GA, Smith AMM, Goring M, Platt PN. The acute hot joint in medical practice. J R Coll Physicians Lond. 1995;29:101–4.
81. Carey TS, Garrett J, Jackman A, et al. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors and orthopedic surgeons. N Engl J Med. 1995;333:913–7.
82. Shekelle PG, Markovich M, Louie R. Comparing the costs between provider types of episodes of back pain care. Spine. 1995;20:221–7.
83. Gunnar RM, Passamani ER, Bourdillon PD, et al. Guidelines for the early management of patients with acute myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on assessment of diagnostic and therapeutic cardiovascular procedures. J Am Coll Cardiol. 1990; 82:664–707.
84. Kaste M, Palomäki H, Sarna S. Where and how should elderly stroke patients be treated? Stroke. 1995;26:249–53.
85. Indredavik B, Bakke F, Solberg R, Rokseth R, Haaheim LL, Holme I. Benefit of a stroke unit: a randomized controlled trial. Stroke. 1991;22:1026–31.
86. Adams AS, Soumerai SB, Lomas J, Ross-Degnan D. The role of social desirability in clinician self-reports of guideline adherence. J Gen Intern Med. 1997;12(suppl 1):64. Abstract.
87. Solomon DH, Bates DW, Panush RS, Katz JN. Costs, outcomes and patient satisfaction by provider type for patients with rheumatic and musculoskeletal conditions: a critical review of the literature and proposed methodologic standards. Ann Intern Med. 1997;127:52–60.
88. Nash DB, Nash IS. Building the best team. Ann Intern Med. 1997;127:72–4.
89. Matz R. Letters to the editor. JAMA. 1996;275:1083–4.
90. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med. 1993;329:977–86.
91. Wennberg J, Gittelsohn A. Variations in medical care among small areas. Sci Am. 1982;246:120–34.
92. Hiss RG, Greenfield S. Forum three: changes in the U.S. health care system that would facilitate improved care for non-insulin-dependent diabetes mellitus. Ann Intern Med. 1996;124(1 pt 2):180–3.