

Economic effects of pharmacists on health outcomes in the United States: A systematic review

MARIE A. CHISHOLM-BURNS, JOSHUA S. GRAFF ZIVIN, JEANNIE KIM LEE, CHRISTINA A. SPIVEY, MARION SLACK, RICHARD N. HERRIER, ELIZABETH HALL-LIPSY, IVO ABRAHAM, AND JOHN PALMER

The U.S. health care system faces several challenges in its quest to improve health care quality and deliver cost-effective service. Despite spending more on health care, the United States generally lags behind other developed nations on significant health indicators.¹ In 2009, the

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United States spent approximately \$2.47 trillion on health care, which equates to approximately \$8047 per person.² This amount represents 17.3% of the entire gross domestic product, which is nearly twice the average that other developed nations spend on health care. An important indicator of the current level of health care quality in the United States is that only half of eligible

Purpose. A systematic review examining the economic effects of pharmacist-provided direct patient care on health outcomes in the United States was conducted.

Methods. A comprehensive literature search was conducted using 13 academic and medical databases. Studies were included in the analysis if they described pharmacist-provided direct patient care, used comparison groups, evaluated economic outcomes, and were conducted in the United States. Outcome results were categorized as (1) favorable, indicating significant improvement as a result of pharmacists' interventions or services, (2) not favorable, indicating significant improvement as a result of nonpharmacist care, (3) mixed, having favorable results on one measure of a study variable but not favorable results or no effect on another, (4) having no effect, indicating no significant difference between pharmacists' interventions or services and the comparison, or (5) unclear, indicating the outcome could not be determined based on presented data.

Results. Of the 56,573 citations considered, a total of 126 studies met the criteria for inclusion in this systematic review. Results favoring pharmacist-provided care were found in 20 studies (15.9%), mixed results were seen in 53 studies (42.1%), no effect was found in 6 studies (4.8%), and unclear results were found in 47 studies (37.3%).

Conclusion. A majority of studies examining the economic effects of pharmacist-provided direct patient care in the United States were limited by their partial analyses, study design, and other analysis considerations. A majority of the 20 studies that found positive economic benefits examined pharmacists' interventions involving technical methods or multimodal approaches.

Index terms: Economics; Interventions; Methodology; Outcomes; Patient care; Pharmaceutical services; Pharmacists; United States

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MARIE A. CHISHOLM-BURNS, PHARM.D., M.P.H., FCCP, FASHP, is Professor and Head, Department of Pharmacy Practice and Science, and Executive Director, Medication Access Program, College of Pharmacy, University of Arizona (UA), Tucson. JOSHUA S. GRAFF ZIVIN, PH.D., is Associate Professor of Economics, International Relations and Pacific Studies, University of California San Diego, San Diego. JEANNIE KIM LEE, PHARM.D., BCPS, is Clinical Assistant Professor; CHRISTINA A. SPIVEY, PH.D., LMSW, is Coordinator of Research and Administration; MARION SLACK, PH.D., is Professor; RICHARD N. HERRIER, PHARM.D., is Clinical Professor; and ELIZABETH HALL-LIPSY, J.D., M.P.H., is Program Manager, Health Disparities Initiatives and Community Outreach, Department of Pharmacy Practice and Science, College of Pharmacy, UA. IVO ABRAHAM, PH.D., RN, is Professor, College of Pharmacy, UA, and Chief Scientist, Matrix45, Earlysville,

VA. JOHN PALMER, M.D., PH.D., is Professor of Pharmacology, College of Medicine, UA.

Address correspondence to Dr. Chisholm-Burns at the Department of Pharmacy Practice and Science, College of Pharmacy, University of Arizona, 1295 North Martin Avenue, P.O. Box 210202, Tucson, AZ 85721 (chisholm@pharmacy.arizona.edu).

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patients receive the recommended preventive, chronic disease, and acute care services.³ A major contributor to shortfalls in providing primary and recommended preventive services is lack of time and expertise.⁴ Pharmacists can help fill this gap in health care provision, especially as members of multidisciplinary teams, as they are specially trained to prevent disease, recommend and monitor medication therapy to achieve desired clinical effects, and reduce adverse health events.⁵⁻⁸ Moreover, pharmacists are highly accessible at both the “point of medication dispensing” and the “point of care” in both inpatient and outpatient care settings. Therefore, pharmacists are well positioned to provide quality, cost-effective, direct patient care.

Previous systematic reviews assessing the effects of pharmacist-provided care on economic outcomes found positive economic benefits associated with pharmacists’ interventions and services as well as widespread deficiencies in economic evaluation and study design.⁹⁻¹³ These findings are generally consistent across studies, despite some methodological variations including (1) limited study inclusion dates, (2) limited inclusion criteria, and (3) the databases searched.

The objective of this study was to contribute to the existing literature by conducting a focused, yet comprehensive systematic review of evidence demonstrating the effects of pharmacists’ direct patient care interventions and services on health economic outcomes in the United States.

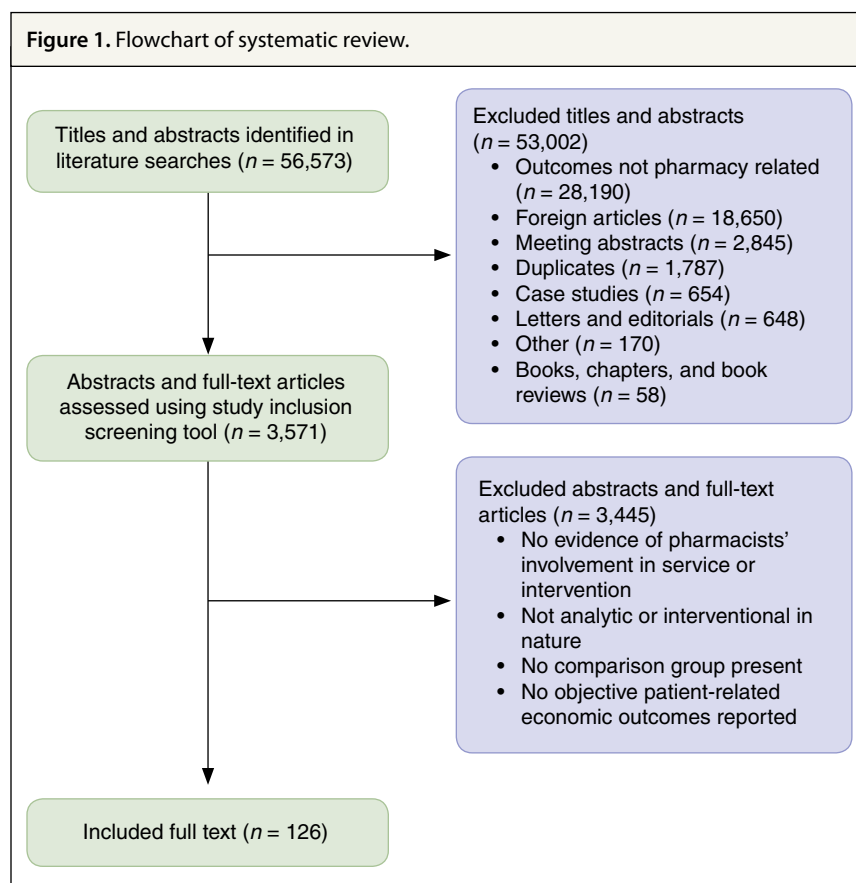
Methods

Data sources and study selection. The methods of this systematic review were based on the *Cochrane Handbook for Systematic Reviews of Interventions*.¹⁴ A comprehensive literature search was conducted for each of the following databases from the start date of the database (noted in parentheses) through

January 2009: PubMed (1950), Ovid/MEDLINE (1950), ABI/INFORM (1971), Health Business Fulltext Elite (1922), Academic Search Complete (1887), International Pharmaceutical Abstracts (1970), PsycINFO (1890), Cochrane Database of Systematic Reviews (1988), National Guideline Clearinghouse (1997), Database of Abstracts of Reviews of Effects (1991), ClinicalTrials.gov (2000), LexisNexis Academic Universe (1789), and Google Scholar (1900). Since this economic systematic review is one part of a larger systematic review project, search terms and strategies specific to each database were used and are further described in an article pertaining to the noneconomic portions of this systematic review project.¹⁵ The reference lists of systematic reviews, meta-analyses, and other review articles were searched to identify

additional articles that may not have been captured in the electronic database search. Duplicate references across databases and references not appropriate to the study were eliminated from the literature search (Figure 1). Due to the potential confounding factors involved in comparing divergent health care systems on economic outcomes, studies conducted only in the United States were considered for inclusion.

Abstracts of studies identified in the literature search were randomly divided into two groups. Each group of abstracts was assigned to one of two independent teams of multidisciplinary reviewers to be assessed for inclusion. To be included in the data extraction process, studies were required to meet all of the following four criteria: (1) evidence of pharmacist involvement in direct patient care, (2) interventional and analytic



methods (i.e., statistical evaluation of pharmacists' direct patient care intervention or service was conducted), (3) presence of a comparison group, and (4) reported economic outcomes.

Economic outcomes were defined as direct (e.g., cost of health care utilization), indirect (e.g., lost productivity), and intangible (e.g., cost of pain and suffering) costs related to health care treatment.¹⁶ Economic analyses were categorized as one of the following¹⁷⁻¹⁹:

- *Cost-minimization analysis.* This analysis assumes that outcomes are identical across intervention groups and simply compares costs.
- *Cost-effectiveness analysis.* This analysis compares clinical endpoints and costs across interventions, thus producing a price per clinical improvement that is further examined to determine whether it is worth the expenditure.
- *Cost-utility analysis.* This is similar to a cost-effectiveness analysis except that it utilizes a benefit measure that reflects both the quality and quantity of life that result from a treatment. The most commonly used utility measure is the quality-adjusted life year.
- *Cost-benefit analysis.* This analysis compares the costs and benefits of treatment alternatives in monetary terms. The benefit measure typically focuses on medical costs avoided and may also assign dollar values to various health states. Outcomes are often represented as a net benefit, net loss, or cost:benefit ratio.

Data extraction and analysis. A standardized data extraction form was developed by team members. The form was pilot tested by selecting 10 articles describing a pharmacist's intervention or service and having two teams (the study review team and a team of two pharmacists not otherwise involved in the study) extract data from the articles using the form. Interrater reliability both

within and between the teams was assessed and determined to be greater than 0.96 ($p < 0.05$). Given the high interrater reliability, the form was deemed appropriate for use in the study.

The study review team consisted of a pharmacist and a doctoral-level economist. Data were extracted from the full text of included studies by each team member independently using the data extraction form. Extracted data were then compared, and any differences between team members' data were identified and resolved via discussion by the team members. A third-party arbitrator was available if consensus could not be reached through discussion but was not needed. Extracted data included study characteristics (e.g., design, setting, length of follow-up), pharmacists' interventions or services and activities, patient characteristics (e.g., age, ethnicity, education level), and study outcomes. Outcome results were collected and categorized as (1) favorable, indicating significant improvement ($p < 0.05$) as a result of pharmacists' interventions or services, (2) not favorable, indicating significant improvement ($p < 0.05$) as a result of nonpharmacist care (generally traditional or usual care), (3) mixed, having favorable results on one measure of a study variable but not favorable results or no effect on another, (4) having no effect, indicating no significant differences ($p > 0.05$) between pharmacists' interventions or services and a comparator, or (5) unclear, as the outcome could not be determined based on presented data.

Data were analyzed using SPSS, version 17.0, software (SPSS Inc., Chicago, IL) by reporting summary statistics (frequencies) of study characteristics and outcomes for all included studies. Similar to previous studies, Pearson's correlation coefficient was used to evaluate the interrater reliability of the review team's findings.²⁰

Results

A total of 126 articles met the criteria for inclusion in this systematic review (Figure 1 and eTable 1).²¹⁻¹⁴⁶ Summary characteristics of the included studies are presented in Table 1. The most frequently reported study settings were outpatient, ambulatory care, retail, and community ($n = 62$, 49%) and inpatient or institutional ($n = 59$, 47%). Only 8 studies included pediatric patients (under 18 years of age), 68 studies included adults age 18–65 years, and 53 studies included adults over age 65 years. Some studies included multiple age groups ($n = 44$), while others did not report age ($n = 33$). In terms of race and ethnicity, white ($n = 28$) and African American ($n = 24$) were the most frequently reported groups, followed by Hispanic ($n = 14$) and an undefined "other" category ($n = 13$). However, race and ethnicity were not reported in 93 and 109 studies, respectively. Education level and patient health care coverage were not reported in 116 and 68 studies, respectively. The most frequently reported diseases were infection ($n = 21$), hypertension ($n = 17$), dyslipidemia ($n = 15$), diabetes ($n = 11$), and asthma or chronic obstructive pulmonary disease ($n = 10$). The majority of studies examined the impact of combination or multimodal interventions ($n = 70$, 55.6%) (Table 1). Many articles reported the use of multiple interventions or services, with the most frequently reported being retrospective and prospective drug-utilization review ($n = 69$), medication education for patients ($n = 42$), medication therapy management ($n = 37$), disease education for patients ($n = 30$), adherence education ($n = 28$), and management of long-term disease ($n = 20$). Results favoring pharmacists' interventions or services versus comparison groups were found in 20 studies (16%), mixed results were found in 53 studies (42%), no effect was found in 6 studies (5%), and unclear results

were found in 47 studies (37%). Interrater reliability for the review team was 0.92 ($p < 0.05$).

Discussion

Among the greatest challenges to improving health care in the United States are (a) providing cost-effective care, (b) encouraging quality care by effectively utilizing professionals in their recognized fields of expertise, and (c) reducing and eliminating health care gaps produced by the increasing shortage of primary care clinicians who provide the majority of care to patients with chronic conditions.¹⁴⁷ More than 133 million Americans have at least one chronic disease, and an estimated 47% of Americans suffer from multiple long-term conditions.¹⁴⁷ Patients with one or more chronic medical conditions currently account for over 75% of the total health care dollars spent,¹⁴⁸ as these individuals are the most frequent users of health care services, primarily home health visits, physician visits, inpatient stays, and prescription medications.¹⁴⁹ It is projected that by 2023, the prevalence of chronic illness in the United States will increase by 42% and that costs associated with these conditions will increase from \$1.3 trillion to \$4.2 trillion annually.¹⁵⁰ Utilizing pharmacists in direct patient care, particularly among patients with chronic medical conditions, may offer a feasible solution to the shortage of primary care providers while enhancing the quality of care (i.e., the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge).¹⁵¹ The pharmacist clinician practice model found within the Indian Health Service and the U.S. Department of Veterans Affairs offers a recognized example of the successful utilization of pharmacists as primary care providers with an expanded scope of care (e.g., prescribing privi-

Table 1.
Characteristics of Studies Included in the Analysis ($n = 126$)

Characteristic	No. (%) Studies
Study setting ^a	
Inpatient or institutional	59 (46.8)
Outpatient, ambulatory care, retail, or community	62 (49.2)
Emergency department or urgent care	0
Home	2 (1.6)
Nursing home or long-term-care facility	4 (3.2)
Pharmacists' interventions ^b	
Behavioral	1 (0.8)
Educational	7 (5.5)
Technical	48 (38.1)
Combination or multimodal	70 (55.6)
Patients' health care coverage ^c	
Medicaid	8 (6.3)
Medicare	5 (4.0)
Department of Veterans Affairs or Department of Defense	22 (17.5)
Managed care or health maintenance organization	10 (7.9)
Private	8 (6.3)
Self-insured	4 (3.2)
Uninsured	1 (0.8)
Not reported	68 (54.0)

^aMore than one study setting was reported in a small number of studies.

^bBehavioral = attempts to modify a patient's behaviors through the use of cues, reminders, and/or reinforcement; educational = focuses on teaching and providing knowledge related to the patient's medical condition and medication regimen; technical = addresses the medication regimen, with strategies including therapeutic change or interchange, simplifying the dosing regimen and/or schedule, and the use of tools such as pillboxes; combination or multimodal = uses strategies from more than one of the above categories (technical, educational, behavioral).

^cMore than one health care coverage provider was reported in a number of studies.

leges).¹⁵²⁻¹⁵⁵ Moreover, pharmacists as direct care providers can play an important role in promoting cost-effective disease management programs, a topic that is increasingly a substantive focus among health care policymakers, consumers, payers, and researchers.¹⁵⁶

Motivated by recognition of the often ineffective and inefficient use of limited health care resources, policymakers and scholars have expanded the traditional focus of health research to include evaluation of intervention or service costs.^{17,157-161} Resource limitations imply an inability to use all potential health interventions and services and create a need for prioritization and selection of the most cost-effective interventions and services. To facilitate such efforts, critical and comprehensive examinations of

the available evidence regarding the costs and benefits of health care interventions and services are needed. Thus, our systematic review summarizes the available evidence of the effects of U.S.-pharmacist-provided direct patient care on economic outcomes.

Economic analyses of intervention or service outcomes and costs are designed to help decision-makers identify the least costly approach to achieving a particular outcome.^{17,162,163} In 1993, the U.S. Public Health Service convened the Panel on Cost-Effectiveness in Health and Medicine, which developed a set of guidelines and recommendations for the conduct of economic evaluations in health care.¹⁶³⁻¹⁶⁵ While the panel made many specific suggestions, an overarching theme was that studies need to have a comprehensive mea-

Table 2.
Studies Demonstrating Improved Economic and Clinical Outcomes with Pharmacists' Interventions or Services^a

Ref.	Disease(s)	Findings
<i>Inpatient/Hospital</i>		
27	Multiple	Shorter log LOS and lower log drug cost per admission with a pharmacist-included health care team ($p < 0.05$), resulting in average cost saving of \$377 per inpatient admission and a benefit-to-cost ratio of 6.03:1
28	Anticoagulation	10.1% higher LOS and 6.6% higher Medicare charges without pharmacist-provided heparin management; 5.9% higher LOS and 2.2% higher Medicare charges without pharmacist-provided warfarin management ($p < 0.0001$ for all) ^b
29	Infection	12.3% higher LOS, 6.3% higher total Medicare charges, 8.2% higher drug charges, and 7.8% higher laboratory charges without pharmacist-managed aminoglycoside/vancomycin therapy ($p < 0.0001$ for all) ^b
30	Epilepsy	14.7% higher LOS ($p = 0.0009$), 11.2% higher Medicare charges ($p = 0.0003$), and 32.2% higher laboratory charges ($p = 0.015$) without pharmacist-managed antiepileptic drug therapy
31	Infection	10.2% higher LOS ($p < 0.0001$), 3.1% higher Medicare charges ($p < 0.0001$), 7.2% higher drug charges ($p = 0.005$), and 2.7% higher laboratory charges ($p = 0.0056$) without pharmacist-managed antimicrobial prophylaxis ^b
32	Multiple	Shorter LOS ($p < 0.0001$) and lower pharmacy and total hospital costs ($p < 0.001$) associated with pharmacist-included treatment team
41	Infection	Lower direct costs among patients receiving pharmacokinetic services ($p < 0.05$)
46	HIV/AIDS	Decreased pharmacy costs per day ($p < 0.001$) with pharmacist-implemented guidelines and interventions
61	Anticoagulation	Lower hospital costs ($p = 0.04$) and shorter LOS ($p = 0.05$) associated with pharmacist-managed care group
<i>Inpatient/Institutional at Discharge, Home</i>		
78	Multiple	Significant differences in hospital charges for the first readmission ($p = 0.02$) and in hospital charges for all readmissions during the first month ($p = 0.01$) and the first 3 mo ($p = 0.03$) between pharmacist discharge and postdischarge consultation versus usual care for geriatric patients

Continued on next page

sure of economic costs. However, the majority of published articles reporting economic outcomes in the current systematic review of pharmacists' interventions and services would best be described as partial cost analyses. They typically examined pharmacists' interventions or services that reduced drug expenditures or lengths of hospital stay and then quantified the economic benefits associated with these reductions. They are partial in that they generally did not attempt to measure all health care costs (appendix).^{162,166} In fact, many analyses limited their focus to drug costs and did not include the costs of the pharmacists' interven-

tions or services. Also, they neglected to measure patients' willingness to pay to avoid various undesirable health outcomes. Thus, the cost-effectiveness studies included in the systematic review tended to focus on a narrow set of cost measures, such as drug or pharmacy costs, rather than a full suite of medical expenditures. These partial measures are problematic, because total costs may be higher even when the subset of measured study costs is lower. Although all studies included in this systematic review had comparison groups, the lack of a comparison group was a common reason for the exclusion of studies in this review.

Thus, the lack of a comparison group was a methodological concern of published economic studies. Other common methodological limitations of included studies were lack of (1) sensitivity analysis, (2) discounting, and (3) robustness checks. Also, few studies measured benefits from a societal perspective, with the majority taking an organizational perspective that restricted their scope to a specific organization or institution (e.g., measuring cost from an individual hospital perspective). These findings are consistent with previous systematic reviews of the economic effects of pharmacists' interventions and services, which identified similar

Table 2 (continued)

Ref.	Disease(s)	Findings
<i>Outpatient/Ambulatory Care</i>		
85	Diabetes	Higher average costs for inpatient hospitalization and ED admissions ($p = 0.015$) without pharmacist-provided diabetes management
88	Hypertension	Higher average provider visit costs per patient in the usual care group versus physician–pharmacist comanagement group ($p = 0.02$)
90	Multiple	Decreased average monthly medication cost per patient by \$0.60 among patients receiving pharmacist-provided medication review versus increased cost of \$3.31 with usual care ($p < 0.001$)
112	Multiple	Decreased total health expenditures from \$11,965 to \$8,197 per person ($p < 0.0001$) and reduction in total expenditures exceeding cost of providing pharmacist-provided MTM services by >12:1
117	Asthma	Fewer ED visits, fewer hospitalizations, and fewer physician visits ($p < 0.05$) with pharmacist-provided education program in conjunction with pulmonologist care versus pulmonologist care alone
127	Heart failure	Fewer ED visits and hospital admissions and lower annual direct health care costs with pharmacist-provided multimodal intervention
132	Asthma	Reduced ED visits for acute exacerbations of asthma ($p < 0.01$) with pharmacist-managed, physician-directed asthma management program
140	Asthma	40% reduction in hospitalizations, 66.6% reduction in ED visits related to asthma, and a significant cost avoidance to the institution ($p = 0.03$) with pharmacist-provided asthma education
<i>Outpatient/Ambulatory Care/Health Maintenance Organization</i>		
86	Dyslipidemia	Average reduced copayments of \$145.29 (62%) per patient (95% CI, \$143–\$149; $p < 0.001$) after converting from simvastatin to lovastatin
<i>Outpatient/Retail</i>		
98	Diabetes, dyslipidemia	Decreased total mean direct medical costs by \$1,200–\$1,872 per patient per year ($p < 0.001$) and decreased sick days every year (1997–2001) for one employer group with estimated increases in productivity of \$18,000 annually for employers' health plans

^aLOS = length of hospital stay, HIV = human immunodeficiency virus, AIDS = acquired immune deficiency syndrome, ED = emergency department, MTM = medication therapy management, CI = confidence interval.

^bCompared hospitals with pharmacist service with those without such a service.

methodological limitations and problematic economic assessments.^{9–13}

Despite the limitations in the majority of included studies, pharmacists' interventions or services were found to be economically beneficial in 20 studies, thus demonstrating the favorable effects of these services on reducing drug expenditures, hospital admissions, lengths of hospital stay, and emergency department visits. The specific economic outcomes and benefits of each of these 20 studies are listed in Table 2. There are several noteworthy characteristics of these studies, including the following: (1) all were published in 1990 or later, (2) the vast major-

ity examined interventions where pharmacists used technical methods involving adjustments to the medication regimen or combination–multimodal approaches, and (3) hospital-based studies typically focused on specific treatments (e.g., aminoglycoside monitoring services), while studies conducted in ambulatory care settings focused on specific diseases, with many concentrating on multidrug regimens, disease management, or switching patients to alternative agents (e.g., therapeutic substitution).

A limitation of this systematic review, as with any systematic review, is the possibility of publication bias.

Publication bias may occur when all studies relevant to a particular inquiry are not published or when studies reporting positive results are more likely to be published than those reporting negative results. While the 126 articles analyzed are representative of the extent and scope of pharmacists' direct patient care interventions or services in published studies, the review may not represent the economic effects used to evaluate and justify the implementation of pharmacists' interventions or services in unpublished studies. The majority of studies analyzed did not report power or sample size analysis; therefore, studies in which

pharmacists' interventions or services had no effect on outcomes may not have been powered sufficiently to detect statistically significant differences. Since statistical significance was greatly relied upon to determine results in the majority of studies, it is important to point out that practical significance may occur in the absence of statistical significance of economic outcomes. In other words, economic benefit relevant to programmatic or organizational needs and priorities may have been noted as a result of pharmacists' interventions and services without reaching statistical significance.

Future studies should build on the literature and focus on using pharmacists' expertise in medication therapy to increase access to health care, maximize the quality time providers spend with patients, and improve the quality of care delivered in an efficient and cost-effective manner.^{100,101} The lack of appropriate statistical analyses on economic endpoints was a common problem found in most studies, and investigators should use appropriate statistical analyses to assess the economic value of services. In addition, studies must use comparison groups and sensitivity analysis, account for costs of interventions and services, and consider costs or benefits from multiple perspectives, including society, institutions, and payers. Finally, investigators should adhere to the guidelines and recommendations of the Panel on Cost-Effectiveness in Health and Medicine and other prominent sources to produce more substantive evidence regarding the economic effects of pharmacists on health care and other outcomes.^{160,162-164}

Conclusion

A majority of studies examining the economic effects of pharmacist-provided direct patient care in the United States were limited by their partial cost analyses, study design, and other analysis considerations. A

majority of the 20 studies that found positive economic benefits examined pharmacists' interventions involving technical methods or multimodal approaches.

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Appendix—Examples of selected direct and indirect health care costs that should be considered in economic studies of pharmacists' direct patient care services^{162,166}

Direct Costs ^a	Indirect Costs ^b
<ul style="list-style-type: none"> Medication costs (e.g., prescription, nonprescription) Costs of medical devices and equipment and other health care supplies Hospitalizations and inpatient care Ambulatory care costs (clinic use) Health care provider office or clinic visits Emergency department visits Preventive care (e.g., screenings, immunizations, vaccinations) Auxiliary services (e.g., dental services, self-management training, ophthalmology and optometry services, podiatry services, chiropractic services) Costs of laboratory tests and procedures 	<ul style="list-style-type: none"> Rehabilitation Occupational therapy and physical therapy Long-term care or nursing home care Hospice or palliative care Home health care services Mental health care services Transportation Days of work lost Time of health care providers Caregiver time Time for medical treatment Time for and costs of treatment of side effects or adverse events

^aExpenses that can be directly attributed to an object such as a product, service, or condition.

^bExpenses not directly related to an object such as a product, service, or condition but that may be incurred as a consequence of a product, service, or condition.

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