ACCP Official Position Statement

Prospectus on the Economic Value of Clinical Pharmacy Services
A Position Statement of the American College of Clinical Pharmacy


A prospectus is a formal summary or brief of a proposed venture. The purpose of this document is therefore to present an overview of the current documentation available to support the economic value of clinical pharmacy services, and to propose a course of action for future documentation of such value based on need. Although much overlap often exists among clinical, distributive, and administrative pharmacy services, this document addresses only those areas in which the predominant service provided is clinical. It was prepared by members of the Clinical Practice Affairs Committee of the ACCP and approved by the Board of Regents on April 10, 1988.

Definitions

A number of economic terms that incorporate the word “cost” appear in the pharmacy literature, such as cost effectiveness, cost benefit, cost justification, cost containment, cost impact, cost analysis, cost savings, and cost avoidance. Various authors define these terms differently, and some use them interchangeably and often inappropriately. As a result, confusion exists with regard to their proper use. A cost analysis compares only the costs of alternative services. Thus, it is only a partial and not a full economic evaluation, since it does not measure the health consequences of alternative services. The cost of providing a service or treatment in monetary terms, while measuring health outcomes in nonmonetary terms, such as length of hospital stay, lives saved, or treatment success or failure. Since health outcomes are measured in nonmonetary terms, however, the cost-effective alternative is not always the least costly. Rather, it is the one that best achieves the desired health outcome at a minimum, acceptable cost.

A cost-benefit analysis differs in that it quantifies both costs and health outcomes or benefits in monetary terms. Therefore, it requires that outcomes such as lives saved or years of life gained be measured in dollars. A cost-benefit analysis has the advantage over a cost-effectiveness analysis of allowing one to calculate a net benefit or value in dollars for each service. However, assigning a dollar value to human lives has its limitations and is objectionable to some clinicians.

A cost-minimization analysis differs only slightly from a cost-effectiveness analysis. In the former, the health outcomes achieved by two or more services are first compared. If found to be identical, the preferable alternative becomes the one that is least costly. In the latter, health outcomes are achieved to varying extents and alternative services are compared by expressing cost per unit of health effect.

Cost-utility analysis quantifies difficult-to-measure outcomes such as quality of life by using utility values such as quality-adjusted life-years. It has only recently been applied to health care services, and has not yet been used to evaluate clinical pharmacy services.

Several other economic terms incorporate the word “cost” and should be correctly defined. A cost analysis compares only the costs of alternative services. Thus, it is only a partial and not a full economic evaluation, since it does not measure the health consequences of alternative services. Many studies in the pharmacy literature are cost analyses that measure cost savings or cost avoidance, often with respect to drug costs. These two terms have subtle difference in meaning. Cost savings result when dollars that were previously spent are no longer spent. Cost avoidance means...
that dollars are not spent from the outset. Whether
dollars are saved or avoided is often subject to one's
interpretation; as a result, it is difficult to distinguish
between the two terms in many studies.

Cost justification, cost containment, and cost
impact are general, often ill-defined terms that are
sometimes used interchangeably and inappropriately
with other economic terms. They can be a
source of confusion as they fail to define the specific
methodology used to evaluate a particular service. Thus, when describing the economic value
of clinical pharmacy services, using more closely
defined economic terms, such as cost effectiveness,
cost benefit, or cost utility, is more specific and preferable.

Needs Assessment for Documenting the
Economic Value of Clinical Pharmacy Services

In this era of rising health care costs, the economic
value of each new and existing service is being
closely scrutinized as society attempts to allocate
limited health care resources wisely and judiciously.
Like many other services, clinical pharmacy services
will continue to be closely examined in this regard.
For new and existing services to survive, clinical
pharmacists will have to demonstrate that they
provide quality health care at an acceptable cost to
society.

Documenting the Economic Value of Clinical
Pharmacy Services

Several review articles have described the eco-

nomic value and acceptance of clinical pharmacy
services as well as methods to justify them.11–14 74
Appendix I summarizes the literature that has at-
tempted to document the economic value of these
services to date.15–73 It includes studies that are
partial or full economic evaluations, but excludes
those in which no comparisons were made between
alternative services or in which no cost data were
provided. Similarly, studies that documented clinical
pharmacy services’ contributions to the quality of
health care, but did not address costs, are not
included. The Appendix does reference some studies
in which hypothetical comparisons were made, in
which patients served as their own controls.
Several studies incorrectly labeled as cost-benefit
analyses by their authors are correctly labeled as
cost analyses in the Appendix.

While a considerable volume of literature has
attempted to address the issue, the number of full
economic evaluations is limited. Many of the studies
are partial evaluations that document cost savings or
cost avoidance but fail to quantify all costs or
measure health outcomes. Those that are full eval-
uations still failed to address the costs of such things
as adverse drug reactions or therapeutic failures.

The extent to which clinical services are tied to
drug-distribution systems is difficult to ascertain in
some studies. For example, most of the ones
evaluating clinical pharmacy services in the emer-
gency room used drug-distribution functions to
determine the economic value and justify the exist-
ence of the clinical pharmacy service.

Many of the studies have been based in family
practice, ambulatory care, and long-term care.49–51, 58–72 Only recently, as a result of new
financial incentives and pressures, has the subject
been addressed in the hospital environment. Three
areas that have received attention are drug therapy
monitoring, pharmacokinetic dosing, and primary
care services.

Drug Therapy Monitoring

Drug therapy monitoring involves (1) selective
monitoring of patients' drug therapy, (2) evaluating
it against predetermined criteria, and (3) consulting
with the prescribing physician to alter therapy when
criteria are not met. While a great deal of literature
exists in this area, most of it covers cost analyses or
partial economic evaluations. An obvious limitation
is that, because patient outcomes are not assessed,
the cost effectiveness, cost benefit, and cost utility of
these services cannot be determined.

Analyses in the acute care environment primarily
dress drug costs; some include personnel and
overhead, but many do not. The costs of adverse
drug reactions or therapeutic failures have largely
been overlooked. In the cost analyses conducted to
date, the largest drug cost savings or avoidance has
been demonstrated with the more expensive drugs,
particularly antibiotics and albumin, for which pro-
jected savings have been as high as $85,000 to
$200,000 annually.17, 26

Several analyses in home health care have doc-
umented substantial patient or third-party payor
savings through shorter hospitalizations.52–58 Most
of these assumed equivalent efficacy and did not
actually compare or document patient outcome
data; thus they were not full economic evaluations.
Studies on the use of psychiatric drugs and total
parenteral nutrition (TPN) are stronger in that they
have documented cost-effectiveness to some ex-
tent.35, 36, 38–40 In many TPN studies, however, in-
termediate outcomes, such as weight gain, were
intermediate rather than final outcomes, such as mor-
bidity and mortality. Analyses in family practice and
long-term care are the strongest, having addressed
drug and personnel costs as well as patient out-
comes.45–51 Several documented the cost-benefit or
cost-effective ness of these services using simplified
models.45, 47, 49, 51

Pharmacokinetic Dosing

Numerous investigations have been conducted
on the economic value of clinical pharmacokinetic
services, but most suffer from some methodologic
flaws. Some have shown decreased "costs" of
serum drug levels based on laboratory charges
rather than actual costs.60, 64–66

A detailed retrospective economic evaluation as-
essed an individualized aminoglycoside dosing
service in burn patients with gram-negative sepsis. Decreased mortality was documented in the study population, and the results convincingly demonstrated the cost benefit of the service to patients and society. Another study noted the cost-effectiveness of a service that monitored digoxin levels, showing patient savings as well as decreased digoxin toxicity and length of hospital stay. Of interest, an evaluation of a theophylline dosing service actually revealed longer hospital stay, increased number of drug level measurements, and no improvement in quality of care. The remaining studies were cost analyses, and thus were not designed to address patient outcome indicators such as drug toxicity, length of stay, or clinical outcome.

Primary Care Services

The economic value of clinical pharmacists as primary care providers was investigated using simplified cost-benefit or cost-effectiveness models. The results point to the economic value of clinical pharmacists as quality primary care providers in a number of settings, such as skilled nursing facilities, hypertension clinics, and anticoagulation clinics. While such results are encouraging, future studies in these and other areas must determine costs and final patient outcomes more thoroughly.

Services in which some documentation of economic value exists, but that lack sufficient documentation in the form of full economic evaluations, include ambulatory patient counseling/compliance monitoring, discharge patient counseling, emergency room services, formulary monitoring and drug review, home health care services, in-service education, medical rounds participation, and patient teaching programs. Services for which there is a total lack of publications on their economic value include cardiopulmonary resuscitation response participation, drug/poison information services, and patient medication histories.

Documenting the Reimbursement of Clinical Pharmacy Services

Reimbursement for clinical pharmacy services in hospitals has been given little attention since the advent of prospective payment programs. It has been pointed out that securing such reimbursement will not increase hospital revenue from third-party payors under many current guidelines. Instead, efforts to justify these services should be directed at the institution rather than at third-party payors.

Reimbursement does, however, play a key role in justifying clinical pharmacy services outside the hospital environment (e.g., family practice, ambulatory care, long-term care facilities) as well as for hospital revenue received from non-third-party payors (e.g., literature searches for law firms, etc.). Clinical pharmacy services may be less likely to be eliminated or reduced if reimbursed directly rather than indirectly under a supplemental drug charge. If they were directly reimbursed, however, they would be more visible to administrators and might conceivably be more likely to be cut if their economic value were not supported. The following major categories of clinical pharmacy services have been documented in the literature as receiving reimbursement: cardiac rehabilitation unit participation; clinical pharmacokinetic services; CPR response participation; drug information services (partial reimbursement); formal education of students (various health professions including pharmacy students); inpatient admission interviews (medication histories); inpatient discharge counseling; patient teaching programs for self-administering medications; TPN or intravenous therapy team participation; and written drug therapy consultations.

Prevalence of Clinical Pharmacy Services

Based on recent national surveys, the percentage of hospitals that provide various clinical pharmacy services is estimated to be as follows: drug therapy monitoring 44–94%; drug information service 75%; in-service education 88–93%; drug therapy consultations 68%; CPR response participation 25–35%; clinical pharmacokinetic services 18–50%; discharge patient counseling 17–46%; medical rounds participation 9–56%; and admission medication histories 5–17%.

The accuracy of these data can be questioned because the published surveys did not target only clinical pharmacy services, and definitions differ among surveys. Also, different reports show widely variant prevalence of some services, possibly due to differences in definitions of services or in the size of the institutions being studied. It is difficult to determine the prevalence of clinical pharmacy services in nonhospital settings due to lack of national surveys.

Future Strategies

Future documentation of the economic value of clinical pharmacy services should be based on need. This means that highly prevalent services whose value is not documented should receive the highest priority for subsequent evaluation. This approach will enable the profession to allocate personnel and financial resources toward those services that have the greatest economic value. The need to continue services that are shown to be of little economic value should be reexamined taking this information into consideration.

It is important to document the economic value of a number of clinical pharmacy services, especially those in the acute care setting. The following should be given the highest priority: drug information services; home health care services; medical rounds participation; CPR response participation; discharge/ambulatory patient counseling; and in-service education.

While a large volume of literature has reported on economic evaluations of such services as drug therapy monitoring and consultation or clinical phar-
macokinetic services, the majority of these studies are only partial or incomplete full evaluations. Comprehensive, full evaluations are required in both areas, although the priority is less than for those services listed above.

Documentation is strongest in the areas of clinical pharmacy services in ambulatory care settings, family practice centers, and long-term care facilities; however, it is not comprehensive, and more data are required. In addition, the economic value of clinical pharmacists as primary care providers in ambulatory settings will probably have to be addressed separately for each specific setting.

Better information also must be obtained as to the prevalence of clinical pharmacy services, especially in nonhospital environments. Such information may well alter the priority placed on documenting the economic value of a given service. Finally, more consistent, comprehensive, formal research methodologies must be applied when assessing the economic value of these services.

Methodologies

Formal research methodologies for conducting sound evaluations of health care services are described in the literature and can be applied to clinical pharmacy services. In addition, the American Society of Hospital Pharmacists has provided funding to develop and validate a technique that can be applied universally to determine the cost impact of various institutional pharmacy services. It is hoped that the results of this study will be instrumental in developing a standard methodology. Finally, collaborative efforts between clinical pharmacists and various pharmacy faculty members, particularly pharmacy administration faculty, can facilitate the development and implementation of sound economic evaluations.

Methodologic Pitfalls in Past Studies

The following methodologic problems commonly appear in the economic evaluations conducted to date:

1. Lack of a concurrent control group. As a result, influential variables (i.e., the Hawthorne effect, certain patient demographics, seasonal variations in drug use, learning effect) are not identified or controlled.
2. Inconsistent definition or complete failure to define the service being evaluated.
3. Failure to specify the perspective from which the study is being conducted (i.e., patient, provider, third-party payor, society).
4. Use of patient charges as a measure of cost rather than determining economic costs, especially with regard to studies involving drug assays and drug charges. Most often, economic costs should be used rather than charges; however, the choice between them depends on the purpose and perspective of the study.
5. Failure to determine the cost of providing the service.
6. Improperly determining the cost of providing the service.
   a. Failure to determine or separate fixed and variable costs.
   b. Failure to include indirect costs (i.e., employee benefits in salary determinations).
   c. Failure to determine impact on other departments or health care providers.
7. Failure to determine actual as opposed to projected outcomes. As a result, studies can only postulate hypothetical impact rather than determine actual impact.
8. Not determining or incompletely determining effectiveness or benefit to patients in terms of clinically relevant outcome indicators.
9. Failure to analyze results using valid statistical tests.

Proposed Methodologies

The following are the major points to consider when developing sound economic evaluations of clinical pharmacy services:

1. Conduct a task analysis of the existing or proposed clinical pharmacy service, breaking down each task into its related components. This must consider components both internal and external to the service. Devise a method for determining the cost of each component; then report it separately so its applicability to other settings can be determined.
2. Predict how the service will influence the process and outcome of health care in the specific setting studied. Devise a method for relating the process and outcome to both economic values (dollars) and relevant, measurable health outcomes. Care should be exercised in determining the true economic costs to an institution. For example, if the frequency of a given procedure is reduced 10% by clinical pharmacy services, the reduction in cost is only the incremental (or variable) cost of the procedure and should not include fixed costs unless these are totally eliminated. Care should be used to differentiate between cost savings and cost avoidance.
3. Establish a concurrent control group, and randomly assign subjects to the control or experimental group if possible. Variability between the groups should be reduced as much as possible. Patient demographics should be similar. Patients should be followed by the same health care providers whenever possible, particularly physicians and clinical pharmacists. This eliminates the inconsistencies that naturally occur in interpreting results and making recommendations when several individuals from the two disciplines collaborate. All other pharmacy services should be provided consistently to both the study and control groups. In addition, a crossover effect where clinical pharmacy services are indirectly or inadvertently provided to the control group should be prevented.
4. If it is not feasible to establish a concurrent control group, a preceding control period for the study can be used. This design suffers from the limitations of maturation and historical effects on the subjects; however, having a control period before the implementation of clinical pharmacy services is often more practical than using a concurrent control. Whichever one is chosen will depend on the setting, which variables can be controlled, and what is logistically possible.

5. Determine the evaluation protocol and evaluating researchers. The personnel and process involved should be least disruptive to the service, yet remove any bias or subjective determination of data.

6. Define the appropriate statistical tests to be used and establish the sample size necessary to ensure adequate statistical power.

7. Interpret the statistical and clinical significance of results and reach decisions regarding the impact of the clinical pharmacy service.

Proposed Plan

The following steps should be taken in response to the need for more studies to document the economic value of clinical pharmacy services:

1. Obtain a better estimate of the prevalence of clearly defined clinical pharmacy services currently provided in institutional, ambulatory, and home health care settings. Comprehensively identify services for which third-party reimbursement is or has been received.

2. Encourage presentation at professional meetings and subsequent publication of cost-benefit, cost-effectiveness, cost-minimization, and cost-utility analyses of clinical pharmacy services.

3. Designate specific research funds for such studies.

4. Publish guidelines for proper research methodologies to be used in the evaluations.

5. Encourage collaboration between clinical pharmacists and other researchers, such as pharmacy administration faculty, in designing and implementing studies.

6. Encourage schools of pharmacy to include sound economic evaluations of clinical pharmacy services in considering faculty for promotion and tenure.

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79. Klopky JC, Billups NF, Hicks CJ. Contract for educational services between a college of pharmacy and private hospital. Am J Hosp Pharm 1984;41:2065-60.


Appendix I. Studies on the Economic Value of Clinical Pharmacy Services

<table>
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<tr>
<th>Clinical Pharmacy Service</th>
<th>Study Objective</th>
<th>Type of Economic Evaluation</th>
<th>Results Obtained</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Counseling</td>
<td>To determine savings to patients as a result of discharge counseling</td>
<td>Cost analysis</td>
<td>Decr. discharge prescription charges to patients</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td>Drug Therapy Monitoring &amp; Consultation (Acute Care) Drugs: Albumin</td>
<td>To examine cost savings to hospital by substituting hetastarch for albumin</td>
<td>Cost analysis</td>
<td>Drug cost savings from switch from albumin to hetastarch</td>
<td>Cost of providing service not addressed No bleeding w/ hetastarch</td>
</tr>
<tr>
<td></td>
<td>To promote the appropriate use of albumin &amp; determine cost savings as a result</td>
<td>Cost analysis</td>
<td>Drug cost savings and decr. inappropriate albumin use</td>
<td>Cost of service/alternative therapies not included Operating room albumin use not included Personnel costs included</td>
</tr>
<tr>
<td></td>
<td>To examine cost savings to hospital by substituting hetastarch for albumin</td>
<td>Cost analysis</td>
<td>Drug cost savings from incr. hetastarch/decr. albumin use</td>
<td>Personnel costs included Net cost savings lumped w/ all clinical services</td>
</tr>
<tr>
<td>Antibiotics (general)</td>
<td>To determine cost avoidance to hospital from antibiotic surveillance service</td>
<td>Cost analysis</td>
<td>Drug cost avoidance demonstrated</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td>Antipseudomonal PCNs</td>
<td>To determine cost savings to hospital by using carbenicillin for ticarcillin</td>
<td>Cost analysis</td>
<td>Net cost savings demonstrated</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>To determine cost savings to hospital by substituting gentamicin for tobramycin</td>
<td>Cost analysis</td>
<td>Drug cost savings from switch from tobramycin to gentamicin</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td></td>
<td>To determine cost savings to hospital by substituting gentamicin for tobramycin</td>
<td>Cost analysis</td>
<td>Drug cost savings from switch from tobramycin to gentamicin Decreased aminoglycoside use</td>
<td>Cost of pharmacist time &amp; alternative drug (when aminoglycoside not used) not included Personnel costs included</td>
</tr>
<tr>
<td></td>
<td>To determine cost savings to hospital by substituting gentamicin for tobramycin</td>
<td>Cost analysis</td>
<td>Drug cost savings from switch from tobramycin to gentamicin Overall drug cost savings to personnel cost ratio &gt; 10:1</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>To examine cost savings to hospital by improving cefazolin dosing &amp; decr. 2nd &amp; 3rd generation ceph use</td>
<td>Cost analysis</td>
<td>Drug cost savings documented Net cost savings and revenue generated reported for all clinical services</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td></td>
<td>To determine cost savings to hospital by substituting cefazolin for cefamandole or cefoxitin as appropriate</td>
<td>Cost analysis</td>
<td>Net cost savings demonstrated</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td></td>
<td>To determine cost savings to hospital by restricting the use of cephalosporins</td>
<td>Cost analysis</td>
<td>Net cost savings demonstrated</td>
<td>Personnel costs included</td>
</tr>
</tbody>
</table>
### Appendix 1. Studies on the Economic Value of Clinical Pharmacy Services (continued)

<table>
<thead>
<tr>
<th>Clinical Pharmacy Service</th>
<th>Study Objective</th>
<th>Type of Economic Evaluation</th>
<th>Results Obtained</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. 25</td>
<td>To determine cost savings to hospital through appropriate cefazolin use</td>
<td>Cost analysis</td>
<td>Net cost savings demonstrated</td>
<td>All costs thoroughly addressed, including personnel costs</td>
</tr>
<tr>
<td>Ref. 26</td>
<td>To determine cost savings to hospital by reducing cefotaxime &amp; moxalactam use</td>
<td>Cost analysis</td>
<td>Potential cost savings shown by decr. inappropriate use</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td>Ref. 27</td>
<td>To determine impact on cephalosporin use &amp; cost savings to hospital with/without service vs. newsletter vs. clinical service</td>
<td>Cost analysis</td>
<td>Drug cost savings demonstrated with clinical service (direct pharmacist-physician interaction)</td>
<td>Cost of providing service not included, Pharmacy newsletter had minimal impact</td>
</tr>
<tr>
<td>Ref. 28</td>
<td>To determine cost savings to hospital by substituting cefazolin for cephalospiorin</td>
<td>Cost analysis</td>
<td>Drug cost savings demonstrated</td>
<td>Pharmacist time involved not included</td>
</tr>
<tr>
<td>Ref. 29</td>
<td>To determine savings to patients and hospital by using cefuroxime for ceftarolam in surgical prophylaxis</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. patient drug charges&lt;br&gt;Decr. drug purchases/inventory&lt;br&gt;Improved revenue vs. expenses&lt;br&gt;Similar wound infection rates</td>
<td>Cost assessment included personnel costs except for clinical pharmacist's time</td>
</tr>
<tr>
<td>Ref. 30</td>
<td>To determine cost savings to hospital through cephalosporin review &amp; restriction</td>
<td>Cost analysis</td>
<td>Net cost savings primarily by substituting cefazolin for cefamandole</td>
<td>Cost assessment included personnel costs except for clinical pharmacist's time</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>To evaluate the impact of medical education on use &amp; cost of corticosteroids in acute COPD exacerbations</td>
<td>Cost analysis</td>
<td>Drug cost savings by reducing intravenous doses &amp; converting to oral corticosteroids&lt;br&gt;Decr. patient charges</td>
<td>Cost of pharmacist time on service not addressed&lt;br&gt;Cost of monthly education by pharmacist included</td>
</tr>
<tr>
<td>Ref. 31</td>
<td>To determine cost savings to hospital through cephalosporin review &amp; restriction</td>
<td>Cost analysis</td>
<td>Drug cost savings demonstrated</td>
<td>Cost of pharmacist time on service not addressed&lt;br&gt;Cost of monthly education by pharmacist included</td>
</tr>
<tr>
<td>Intravenous Therapy</td>
<td>To determine cost savings to hospital by discontinuing IV therapy when appropriate</td>
<td>Cost analysis</td>
<td>Drug &amp; labor cost savings as a result of decr. IV admixture waste</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td>Ref. 32</td>
<td>To determine cost savings to hospital &amp; patient by reducing IV therapy use</td>
<td>Cost analysis</td>
<td>Decr. number, cost &amp; duration of IV fluids &amp; medications</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td>Non-formulary Drug Use</td>
<td>To determine cost avoidance to hospital by reducing non-formulary drug use</td>
<td>Cost analysis</td>
<td>Cost avoidance (nonformulary-formulary drug costs) shown&lt;br&gt;Decr. non-formulary drug use</td>
<td>Personnel costs included&lt;br&gt;Decentralized services &gt; success than centralized</td>
</tr>
<tr>
<td>Psychiatric Drugs</td>
<td>To determine the impact on quality and cost of health care to psychiatric patients in a day treatment center</td>
<td>Cost-effectiveness analysis</td>
<td>Quality of care &gt; pre-study: same mental function; improved compliance; decr. ADR, # drugs&lt;br&gt;Decr. drug &amp; labor costs</td>
<td>Personnel costs included; additional costs thought to be minimal, but not measured</td>
</tr>
<tr>
<td>Ref. 35</td>
<td>To determine the impact on quality and cost of health care to psychiatric patients in an acute care facility</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. # of drugs &amp; doses used&lt;br&gt;Decr. LOS, time on acute care unit, readmission rate over 1 year follow-up/patient</td>
<td>Cost savings appear substantial but costs incompletely assessed</td>
</tr>
<tr>
<td>Ref. 36</td>
<td>To evaluate the impact on quality and cost of health care to psychiatric patients in an acute care facility</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. number, cost &amp; duration of IV fluids &amp; medications</td>
<td>Cost of providing service not addressed</td>
</tr>
<tr>
<td>Clinical Pharmacy Service</td>
<td>Study Objective</td>
<td>Type of Economic Evaluation</td>
<td>Results Obtained</td>
<td>Comments</td>
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<tr>
<td>Theophylline</td>
<td>To evaluate the impact of medical education on use &amp; cost of theophylline in COPD</td>
<td>Cost analysis</td>
<td>Decr. length of IV therapy, drug &amp; pump costs/charges from early switch to po theophylline</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td>TPN</td>
<td>To evaluate the impact on quality and cost of TPN in a neonatal intensive-care unit</td>
<td>Cost-effectiveness analysis</td>
<td>Incr. total costs but decr. daily cost/gm of weight gain Improved nutrit. status (wt gain)</td>
<td>Personnel costs included Final outcomes (morbidity, mortality) not assessed Fees used instead of costs Final outcomes not assessed</td>
</tr>
<tr>
<td>Ref. 39</td>
<td>To evaluate the impact on quality and cost of TPN in pediatric patients</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. TPN charges, waste Incr. monitoring charges Improved nutrit. status (wt gain)</td>
<td></td>
</tr>
<tr>
<td>Ref. 40</td>
<td>To evaluate the impact on quality and cost of TPN by using standard TPN solutions</td>
<td>Cost-effectiveness analysis</td>
<td>Incr. # of patients on TPN Cost savings due to incr. use of standard TPN &amp; decr. waste</td>
<td>Outcome data not presented but medical staff audit noted improved quality</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>To determine cost savings to hospital by substituting nafcillin for vancomycin</td>
<td>Cost analysis</td>
<td>Drug cost savings from switch from vancomycin to nafcillin Overall drug cost savings to personnel costs ratio &gt; 10:1</td>
<td>Personnel costs included</td>
</tr>
<tr>
<td>Other: Other:</td>
<td>Orthopedic Unit</td>
<td>To determine the impact on cost of all drug therapy, antibiotic use, &amp; on LOS</td>
<td>Cost-minimization analysis</td>
<td>Decr. drug costs (especially antibiotics); no difference in LOS (clinical outcome)</td>
</tr>
<tr>
<td>Ref. 41</td>
<td>Cardiothoracic/vasc unit</td>
<td>To determine the impact on cost of all drug therapy, antibiotic use, &amp; on LOS</td>
<td>Cost-minimization analysis</td>
<td>Decr. drug costs (especially antibiotics); no difference in LOS (clinical outcome)</td>
</tr>
<tr>
<td>Streptococcal pneumonia</td>
<td>To determine the impact on the management of pneumococcal pneumonia</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. total antibiotic costs Decr. LOS postulated No readmissions in either group</td>
<td>Cost of providing service not included</td>
</tr>
<tr>
<td>Ref. 43</td>
<td>Orthopedic/Oncology Units</td>
<td>To examine decentralized services' impact on communication patterns/hospital drug costs</td>
<td>Cost analysis</td>
<td>Decr. targeted drug costs Improved communication with nurses, physicians</td>
</tr>
<tr>
<td>Drug Therapy Monitoring &amp; Consultation (Family Practice)</td>
<td>Ref. 45</td>
<td>To determine net benefit to patients using cost-benefit analysis model in 3 offices</td>
<td>Cost-benefit analysis</td>
<td>Decr. physician time spent, referrals Incr. quality of care, appt. compliance rate</td>
</tr>
<tr>
<td>Ref. 46</td>
<td>To conduct comparative task &amp; cost (to patient) analysis of services provided in 3 offices</td>
<td>Cost analysis</td>
<td>Total costs per prescription plus net profit Rx prices comparable to national average</td>
<td></td>
</tr>
<tr>
<td>Clinical Pharmacy Service</td>
<td>Study Objective</td>
<td>Type of Evaluation</td>
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<td>Comments</td>
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<td>----------------------------------------------------------------</td>
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</tr>
<tr>
<td>Drug Therapy Monitoring &amp; Consultation (Long Term Care)</td>
<td>To compare quality &amp; cost of anti-HTN drug therapy to patients before/after services</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. antihypertensive drug costs, hypotensive readings, abnormal potassium levels</td>
<td>Cost of providing service not included</td>
</tr>
<tr>
<td>Ref. 47</td>
<td>To examine the impact on health care costs to patients in skilled nursing facility</td>
<td>Cost analysis</td>
<td>Net cost savings to 3rd party payers; decr. hospitalization due to ADRs, improved quality</td>
<td>Personnel &amp; overhead costs included</td>
</tr>
<tr>
<td>Ref. 48</td>
<td>To examine the impact on drug use &amp; costs to patients in LTCF over an 8-year period</td>
<td>Cost analysis</td>
<td>Decr. prescription and OTC drug use &amp; costs (prices) to patients or 3rd party payers</td>
<td>Personnel costs not included; impact of clinical services not isolated</td>
</tr>
<tr>
<td>Ref. 50</td>
<td>To examine the effect of initiating/stopping/reinitiating services to LTCF patients</td>
<td>Cost analysis</td>
<td>Decr. # drugs/charges, adm/disch/death rate; incr. hosp. rate; usage patterns reversed without clinical services</td>
<td>Fee for service, Rx charges used; cause &amp; effect for turnover rates &amp; services not established</td>
</tr>
<tr>
<td>Ref. 51</td>
<td>To examine the impact on quality &amp; cost of health care to patients in SNF</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. # drugs/costs, med errors Estimated decr. ADRs, decr. hosp. rate/ costs as a result</td>
<td>Cost of providing service not included</td>
</tr>
<tr>
<td>Drug Therapy Monitoring, Consultation &amp; Patient Teaching (Home Care) TPN</td>
<td>To determine pharmacy costs &amp; patient charges for TPN in home vs. hospital setting</td>
<td>Cost analysis</td>
<td>For home TPN, pharmacy costs (except implementation costs) recovered; net patient savings</td>
<td>Direct &amp; indirect pharmacy costs &amp; patient charges fully assessed</td>
</tr>
<tr>
<td>Ref. 52</td>
<td>To determine hospital costs &amp; patient charges for TPN in home vs. hospital setting</td>
<td>Cost analysis</td>
<td>Net savings to patient for home TPN compared to TPN in hospital; hosp-days avoided</td>
<td>Direct hospital costs &amp; patient charges thoroughly assessed</td>
</tr>
<tr>
<td>Ref. 53</td>
<td>To study the cost-effectiveness of pharmacist-conducted home TPN training program</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. estimated # hosp-days &amp; charges; net estimated savings to patient &amp; society measured</td>
<td>Pharmacy charges used</td>
</tr>
<tr>
<td>Ref. 54</td>
<td>To determine the cost savings to patients for outpatient IV antibiotic therapy</td>
<td>Cost analysis</td>
<td>Net savings in patient or 3rd party payer charges; clinical successes/minimal complications; hosp-days avoided</td>
<td>Direct hosp. costs, patient &amp; hospitalization charges measured; cost analysis &amp; outcome description</td>
</tr>
<tr>
<td>Ref. 56</td>
<td>To describe the efficacy &amp; determine cost savings to patients for home IV antibiotics</td>
<td>Cost analysis</td>
<td>Net savings in patient or 3rd party payer charges; treatment successful/no complications</td>
<td>Actual patient charges vs potential hosp. charges compared; cost analysis &amp; outcome description</td>
</tr>
<tr>
<td>Ref. 54</td>
<td>To study the cost-effectiveness of pharmacist-conducted training program in home self-administration of meds</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. estimated # hosp-days &amp; charges; net estimated savings to patient &amp; society measured for various medications</td>
<td>Pharmacy charges used</td>
</tr>
</tbody>
</table>

"Improved care" = decr. # of hosp-days or clinic visits
### Appendix 1. Studies on the Economic Value of Clinical Pharmacy Services (continued)

<table>
<thead>
<tr>
<th>Clinical Pharmacy Service</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Miscellaneous</strong>&lt;br&gt;Ref. 57</td>
<td>To describe a pharmacist-conducted training program in home self-administration of antihemophilic factor (AHF)</td>
<td>Cost analysis</td>
<td>Net savings to patients &amp; 3rd party payers for home AHF compared to previous situation</td>
<td>Cost of pharmacist time not included; other costs assessed; 3rd party reimbursement obtained</td>
</tr>
<tr>
<td>Ref. 58</td>
<td>To describe a pharmacist-conducted training program for adrenalectomy patients</td>
<td>Cost analysis</td>
<td>Decreased healthcare charges to patients &amp;/or 3rd party payers</td>
<td>Cost of pharmacist time not included; 3rd party reimbursement obtained</td>
</tr>
<tr>
<td><strong>Pharmacokinetic Service</strong>&lt;br&gt;Aminoglycosides&lt;br&gt;Ref. 59</td>
<td>To evaluate the impact of individualized gentamicin dosing on patient outcomes using cost-benefit analysis</td>
<td>Cost-benefit analysis</td>
<td>Kinetic group: decreased mortality, increased infection duration, Benefit: cost ratio = 8.7:1 using 6% discount rate</td>
<td>Detailed application of cost-benefit model to patients &amp; society, Retrospective study</td>
</tr>
<tr>
<td>Ref. 60</td>
<td>To determine cost savings to patients and the hospital by individualized dosing service</td>
<td>Cost analysis</td>
<td>Decreased patient drug charges, Savings to hospital by decreased personnel &amp; supply costs</td>
<td>Personnel costs included, Drug &amp; lab charges used to calculate patient savings</td>
</tr>
<tr>
<td>Ref. 61</td>
<td>To evaluate the impact of aminoglycoside dosing to the hospital &amp; patients using cost-benefit analysis</td>
<td>Cost-benefit analysis</td>
<td>Patient outcomes similar, Benefit: cost ratio = 1.13:1, Benefit mainly when switched from tobramycin to gentamicin</td>
<td>Simplified application of cost-benefit model, Thorough cost assessment, Prospective study</td>
</tr>
<tr>
<td>Ref. 62</td>
<td>To document the need for a computerized aminoglycoside dosing service</td>
<td>Cost analysis</td>
<td>Potential savings to patients, Potential for more optimal use of serum drug level data</td>
<td>Conducted to illustrate need for a dosing service</td>
</tr>
<tr>
<td><strong>Digoxin</strong>&lt;br&gt;Ref. 63</td>
<td>To determine the impact of digoxin level monitoring on quality/cost of patient care</td>
<td>Cost-effectiveness analysis</td>
<td>Net cost savings to patients from decreased digoxin assays, Decreased LOS, digoxin toxicity</td>
<td>Personnel costs included, Decr. inappropriately drawn or unnecessary dig. assays</td>
</tr>
<tr>
<td>Ref. 64</td>
<td>To determine the effect of theophylline level monitoring on quality/cost of pt. care</td>
<td>Cost-effectiveness analysis</td>
<td>No improved quality of care, Incr. LOS, # of drug levels, pt. charges in kinetic group</td>
<td>Personnel costs included, Service not cost-effective under the study conditions</td>
</tr>
<tr>
<td><strong>General</strong>&lt;br&gt;Ref. 65</td>
<td>To determine the impact on the use &amp; cost of serum drug level monitoring</td>
<td>Cost analysis</td>
<td>Decreased # of unnecessary drug levels, Net patient charge savings</td>
<td>Personnel costs included, Lab charges rather than costs used</td>
</tr>
<tr>
<td>Ref. 66</td>
<td>To determine the impact on the use &amp; cost of serum drug level monitoring</td>
<td>Cost analysis</td>
<td>Appropriate use of serum drug levels incr. significantly, Net patient charge savings</td>
<td>Personnel costs included, Lab charges used; included physician education</td>
</tr>
</tbody>
</table>
### Appendix I. Studies on the Economic Value of Clinical Pharmacy Services (continued)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Medical Rounds Participation</td>
<td>To conduct a cost-effectiveness analysis of 3 methods of identifying possible drug-related problems (PDRP)</td>
<td>Cost-effectiveness analysis</td>
<td>Cost/PDRP highest for rounding &gt; chart review &gt; pt. drug profiles; but more clinically significant problems found on rounds</td>
<td>Personnel costs included. More information obtained, better rapport established by rounding</td>
</tr>
<tr>
<td>Primary Care</td>
<td>To evaluate the impact of a clinical pharmacist on quality &amp; cost of care in SNF patients</td>
<td>Cost-effectiveness analysis</td>
<td>Decr. mortality, hosp. rate, # of drugs; incr. discharges to home/lower levels of care</td>
<td>Personnel costs included. Prescribing supervised by family practitioner</td>
</tr>
<tr>
<td></td>
<td>To evaluate the impact of a clinical pharmacist &amp; nurse clinician on quality/cost of care in ambulatory care clinic</td>
<td>Cost-effectiveness analysis</td>
<td>Person time included. Involved rheumatology &amp; renal clinics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>To evaluate clinical pharmacist's management of strep throat infections in an HMO</td>
<td>Cost-minimization analysis</td>
<td>Efficacy same, personnel time &amp; cost per case less</td>
<td>Limited cost assessment. Hypothetical manpower costs used</td>
</tr>
<tr>
<td></td>
<td>To evaluate cost-effectiveness of clinical pharmacist in a medication refill clinic</td>
<td>Cost-effectiveness analysis</td>
<td>Correct refill decisions made (judged by physicians), cost per visit less than for MD</td>
<td>Personnel costs included. Measured outcome = correct refill decision</td>
</tr>
<tr>
<td></td>
<td>To conduct cost-benefit analysis of clinical pharmacist-managed anticoagulation clinic</td>
<td>Cost-benefit analysis</td>
<td>Incr. % therapeutic PT ratios</td>
<td>Simplified cost-benefit model applied</td>
</tr>
<tr>
<td></td>
<td>To conduct a comparative analysis of clinical services in 3 hospital settings</td>
<td>Cost analysis</td>
<td>Conducted more extensive adm medication histories than MDs</td>
<td>Justified clinical pharmacist position</td>
</tr>
</tbody>
</table>

**Comprehensive clinical services**

| Ref. 73 | To conduct a comparative time and cost analysis of clinical services in 3 hospital settings | Cost analysis | Conducted more extensive adm medication histories than MDs | Clinical activities: adm drug histories, drug therapy monitoring, drug info. & discharge consults |

Abbreviations: adm = admission; ADRs = adverse drug reactions; AHF = antihemophilic factor; antiHTN = antihypertensive; appt = appointment; AWP = average wholesale price; BP = blood pressure; ceph = cephalosporins; COPD = chronic obstructive pulmonary disease; decr = decreased; dig = digoxin; disch = discharge; HMO = health maintenance organization; hosp = hospital or hospitalization; hosp-days = hospital-days; incr = increased; info = information; IV = intravenous; LOS = length of stay; LTCF = long-term care facility; med = medication; nutr = nutritional; PDRP = possible drug-related problems; po = oral; PT = prothrombin time; pt = patient; Rx = prescription; SNF = skilled nursing facility; TPN = total parenteral nutrition; w/ = with; wt = weight; 2nd &/or 3rd gen cephs = second &/or third generation cephalosporins.