Economic Evaluation of Hospital and Community Pharmacy Services

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Abstract

Objective: To review the international body of literature from 2010 to 2015 concerning methods of economic evaluations used in hospital- and community-based studies of pharmacy services in publicly funded health systems worldwide, their clinical outcomes, and economic effectiveness. **Data Sources:** The literature search was undertaken between May 2, 2015, and September 4, 2015. Keywords included "health economics" and "evaluation" "assessment" or "appraisal," "methods," "hospital" or "community" or "residential care," "pharmacy" or "pharmacy services" and "cost minimisation analysis" or "cost utility analysis" or "cost effectiveness analysis" or "cost benefit analysis." The databases searched included MEDLINE, PubMed, Google Scholar, Science Direct, Springer Links, and Scopus, and journals searched included *PLoS One, PLoS Medicine, Nature, Health Policy, Pharmacoeconomics, The European Journal of Health Economics, Expert Review of Pharmacoeconomics and Outcomes Research*, and *Journal of Health Economics*. **Study Selection and Data Extraction:** Studies were selected on the basis of study inclusion criteria. These criteria included full-text original research articles undertaking an economic evaluation of hospital- or community-based pharmacy services in peer-reviewed scientific journals and in English, in countries with a publicly funded health system published between 2010 and 2015. **Data Synthesis:** 14 articles were included in this review. Cost-utility analysis (CUA) was the most utilized measure. Cost-minimization analysis (CMA) was not used by any studies. The limited use of cost-benefit analyses (CBAs) is likely a result of technical challenges in quantifying the cost of clinical benefits, risks, and outcomes. Hospital pharmacy services provided clinical benefits including improvements in patient health outcomes and reductions in adverse medication use, and all studies were considered cost-effective due to meeting a cost-utility (per quality-adjusted life year) threshold or were cost saving. Community pharmacy services were considered cost-effective in 8 of 10 studies. **Conclusions:** Economic evaluations of hospital and community pharmacy services are becoming increasingly commonplace to enable an understanding of which health care services provide value for money and to inform policy makers as to which services will be cost-effective in light of limited health care resources.

Keywords

pharmacoeconomics, pharmaceutical care, clinical pharmacy, cost-benefit, cost-effectiveness

Introduction

Research consistently demonstrates the clinical and socio-economic benefits of pharmacy and pharmacist directed care of patients in hospital and community settings.[1] Economic evaluation of pharmacy services has become increasingly commonplace to evaluate the value for money that these services provide.[1] These evaluations most often look to evaluate the clinical cost-effectiveness of medicines with the aim of distributing limited health resources to those medicines that show sufficient levels of clinical efficacy and value for money.[1,2] Health economics methodologies and economic evaluations are increasingly utilized in choosing between the most clinically cost-effective programs and technologies in health care. Growing pressure to get the best value for money has pressured policy makers and governments to utilize health-economic evaluation tools. This has contributed to the increasing number of evaluations regarding the efficacy and effectiveness of pharmacy services.[2,3] Within the passing years, pharmacy

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services have transformed from a role primarily focused on medicine dispensing and delivery to involving pharmacists in providing individualized expert care as an important part of health care teams.[1] It is of increasing importance to evaluate the efficacy and effectiveness of such services in pharmacy-based research and practice.

Economic evaluations of pharmacy services most commonly involve 4 types of pharmacoeconomic analyses: cost-minimization analysis (CMA), cost-effectiveness analysis (CEA), cost-benefit analysis (CBA), and cost-utility analysis (CUA).[4] Techniques for the economic evaluation of health care interventions are designed to compare alternate interventions in terms of consequences (benefits) and costs.[5,6] It is to be noted that although a number of previous studies have included the cost related with community and hospital pharmacy services, the vigorous use of pharmacoeconomic analysis for these services is limited.[2] It has become increasingly important to conduct and evaluate well-designed economic studies of these services to obtain a clear scenario regarding their economic impact. Well-designed pharmacoeconomic studies further enable rationalization of limited health care resources.[3] The primary objective of this article is to provide a review synthesizing the updated international body of literature from 2010 to 2015 concerning various methods of health-economic evaluations used in hospital- and community-based studies of pharmacy services, their clinical outcomes, and cost-effectiveness.

Methods

Search Strategy

The PRISMA guidelines for conducting systematic reviews were used.[7] The literature search was undertaken between May 2, 2015, and September 4, 2015, to identify published peer-reviewed articles in English. A search strategy was developed and implemented under the leadership of ZB and SV. Keywords included the following: "health economics" and "evaluation" "assessment" or "appraisal," "methods," "hospital" or "community" or "residential care," "pharmacy" or "pharmacy services" and "cost minimisation analysis" or "cost utility analysis" or "cost effectiveness analysis" or "cost benefit analysis." The keywords were combined and incorporated in database and journal searches. No review protocol exists currently for this review.

The databases searched (by TG) included the following: MEDLINE (2010-2015), PubMed (2010-2015), Google Scholar (2010-2015), ScienceDirect (2010-2015), Springer Links (2010-2015), and Scopus (2010-2015). We also searched the following journals: *PLoS One* (2010-2015), *PLoS Medicine* (2010-2015), *Nature* (2010-2015), *Health Policy* (2010-2015), *Pharmacoeconomics* (2010-2015), *The European Journal of Health Economics* (2010-2015), *Expert Review of Pharmacoeconomics and Outcomes Research* (2010-2015), and *Journal of Health Economics* (2010-2015). Search results are detailed in Table 1 by database and journal. References of retrieved articles were considered for relevant articles that may have been missed.

In the search process, Boolean operator rules were used.[2,7] The terms used were searched using AND to combine the keywords listed and OR to remove search duplication where possible.

Article Selection and Data Collection

The title and abstract of all retrieved articles were reviewed by the lead author (TG) for relevance. If there was any uncertainty about the article, the full-text article was retrieved and read for relevance. Articles were included if they detailed and/or utilized health-economic evaluation methods in either a hospital- or community-based pharmacy setting. We only included articles published in peer-reviewed journals and in English. Studies were also limited to countries with a publicly funded health care system; this was to ensure applicability of results to this type of health system and funding.

From the database/journal searches, 34 865 titles/abstracts were retrieved (Table 1). Table 1 indicates the number of search results by database/journal from initial searches. After removing 34 804 duplicates and titles/abstracts unrelated to health-economic evaluations of hospital and pharmacy services (and methodologies utilized), we identified 55 peer-reviewed articles in English. Six more articles were identified from references of the retrieved articles; therefore, 61 articles were considered against our study inclusion/exclusion criteria provided in Table 2. TG and ZB read these articles in full, with contribution from SV. We aimed to include only studies that were published in the past 5 years (2010-2015); for this reason, 2 studies were excluded based on year of publication, and 8 studies were excluded based on article type—that is, these studies were not original (primary) research. Of these, only 14 articles were relevant to health-economic evaluations and methodologies used there within hospital- and/or community-based pharmacy services. Therefore, based on these criteria, 14 articles were included for analysis (Figure 1).

Data collected on individual articles included the following: author, objective or aim if any, setting (hospital, community, or residential care based), dates of data collection or article publication, health-economic evaluation methodology utilized/discussed, research methodology if any, collected data if any, and outcome measures if any. Studies were analyzed for bias, including internal and external validity measures: bias resulting from confounding, bias in the selection of participants into the study, bias in measurements of interventions, bias resulting from departures of intended interventions, bias resulting from missing data,

Table 1. Number of Search Results ("Hits") by Database or Journal.

	("Economic Evaluation") AND ("Pharmacy" or "Pharmacy Services")	("Health economic") AND ("Evaluation" or "Assessment" or "Appraisal") AND ("Hospital" or "Community" or residential care) AND ("Pharmacy" or "Pharmacy Services")	("Health economic") AND ("Evaluation") AND ("Methods") AND (" Hospital," "residential care" or "Community) AND ("Pharmacy" or "Pharmacy Services")	("Health" or "Health-care") AND ("Economic") AND ("Evaluation" or "Assessment" or "Appraisal") AND ("Hospital," "residential care" or "Community) AND (Pharmacy" or "Pharmacy Services")	("Economic Evaluation") AND ("Health" or "Health-care") AND ("Pharmacy" or "Pharmacy Services") AND ("Cost minimization analysis" or "Cost utility analysis" or "Cost effectiveness analysis" or "Cost benefit analysis")
Databases					
Google Scholar	149 000	5920	16 700	3130	16 700
MEDLINE	480	—	—	—	—
PubMed	1098	—	299	—	3
ScienceDirect	5889	1681	1817	—	—
Springer Links	5807	431	391	320	262
Scopus	258	156	89	157	131
Journals					
PLoS One	533	32	—	31	508
PLoS Medicine	62	9	—	9	69
Nature	146	—	—	—	—
Health Policy	133	—	3	—	—
Pharmacoeconomics	223	132	—	3	37
The European Journal of Health Economics	92	39	32	—	—
Expert Review of Pharmacoeconomics and Outcomes Research	3406	—	—	—	—
Journal of Health Economics	38	—	—	—	—

Table 2. Study Inclusion and Exclusion Criteria.

No.	Category	Inclusion Criteria
1	Year of release	2010-2015
2	Publication type	Full-text original research articles in peer-reviewed scientific journals and in English
3	Countries covered	Countries with a publicly funded health system and those that undertake (various) heath economic methodologies and evaluations of hospital- and/or community-based pharmacy services
4	Health care setting	Hospital-, community-, residential care–, and aged care–based pharmacy service
5	Methodologies of economic evaluation	Any utilized in the evaluation of hospital- and/or community-based pharmacy services, including, but not limited to cost-minimization analysis (CMA), cost-effectiveness analysis (CEA), cost-benefit analysis (CBA), cost-utility analysis (CUA)
6	Definitions and issues to include	• Health economics, pharmacoeconomics, pharmacy practice, economic evaluation, hospital pharmacy services, community pharmacy services • Definition of pharmacoeconomics • Economic evaluation, costs, benefits, outcome measures • Discounting, sensitivity analysis • CMA, CEA, CBA, CUA
7	Methodology and topic of research	Systematic review of peer-reviewed journal articles investigating and/or utilizing methods of economic evaluations used for hospital- and/or community-based studies
No.		Exclusion Criteria
1		Articles not published in the English language
2		Reviews, news reports, editorials, commentaries, opinions

bias in measurement of outcomes, and bias in the selection of the reported result. No significant bias that would affect the cumulative results reported was found.

After the extraction of relevant information, a narrative synthesis was undertaken.

Analysis

A systematic literature review was undertaken to ensure that the narrative synthesis developed within is based on the most complete base of literature regarding health-economic evaluation of hospital and community pharmacy-based services. Through consideration of methodologies of evaluation utilized, we were able to identify the primary methods of health-economic evaluations used in hospital and community-based studies of pharmacy services and frequency of their use as well as the clinical outcomes and cost-effectiveness of these services through descriptive analysis. Table 3 provides a brief summary of the methods of economic evaluation and pharmacoeconomic analyses utilized by studies in this review. Table 4 provides a general overview of the characteristics of the included studies.

Results

Setting and Methods of Economic Evaluations of Hospital and Community Pharmacy Services

The 14 articles utilized various methods of health-economic evaluations in hospital and/or community-based studies of pharmacy services (summary provided in Table 4). Studies were organized by setting of intervention—hospital (n = 4)[3,6,8,9] and community (n = 10)[5,10-18]—as well as method of economic evaluation—CMA (n = 0), CEA (n = 2),[5,17] CBA (n = 2),[3,9] and CUA (n = 10).[6,8,10-16,-18] There were a number of studies that focused on economic evaluations of hospital pharmacy services. This included utilization of a clinical pharmacist as part of a health care team (ie, supplementing physicians to reduce the risk of adverse events) or pharmacists providing education regarding medications and self-care.[3,6,8,9] Community-based studies focused on medication or disease-specific education (often for chronic diseases such as type 2 diabetes), medication management programs, medication review, or follow-up support.[5,10-18]

Methods of economic evaluation such as CMA, CEA, CBA, and CUA were developed to assist decision makers in comparing the value of alternative interventions in health care. CUA was the most widely utilized methodology. All other methods were also utilized in included studies[6,8,9] except CMA.

CUA facilitates the comparison of health care interventions without placing monetary values on health states. As such, CUA addresses problems with conventional CEA analyses, which do not allow comparisons across different health problems.[6] Considering the increasing number of multiattribute utility instruments, which can generate health utilities for CUA, CUA is increasingly emerging as the preferred method of economic evaluation of health care interventions and was noted as the most common methodology of pharmacoeconomic analysis in the 14 studies included in this review.

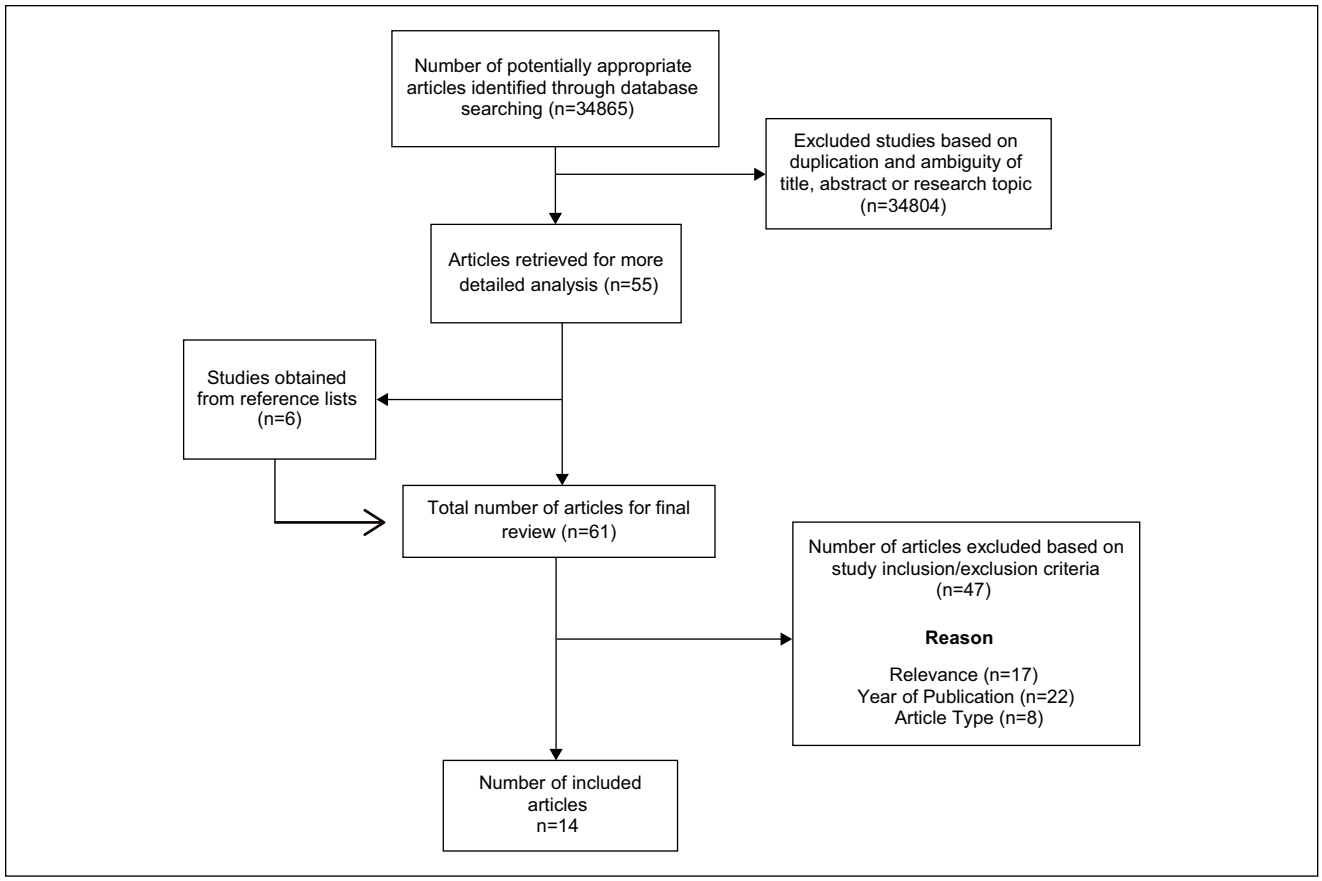

Figure 1. Study selection flow diagram (based on PRISMA guidelines).

Table 3. Common Methods of Pharmacoeconomic Analysis and Economic Evaluation.[2,4]

Method	Description	Example of Practical Applications
Cost-minimization analysis	Analysis deals only with costs. In particular, this analysis is utilized to recognize the most inexpensive option when effectiveness of appraisals are identical	May be applied when comparing generics of the same medicine or selecting medicines from the same class
Cost-effectiveness analysis (CEA)	Method of analysis is utilized to compare options when effectiveness is not identical. CEA considers a single measure of output, with results often expressed in a cost-effectiveness ratio—that is, $1000 per life-year gained or as natural units, such as years of life gained. CEA also requires use of the same unit for comparison of the health interventions or programs compared	Identification of most economical option in comparing a pharmacist-led diabetes management education program compared with standard care[5,19]
Cost-benefit analysis	Method of analysis is utilized to compare options when effectiveness is not identical. Values consequences (benefits) of programs are in monetary terms to allow comparison with costs. Outcomes are measured as net or total dollar benefit	Identification of most economical option in evaluating the clinical and economic impact of pharmaceutical care (pharmacist presence at each physician appointment) of HIV-infected patients compared with standard care[6]
Cost-utility analysis (CUA)	Analysis to identify the most cost-effective option or course of action. CUA measures the benefits or consequences of interventions by utility weights or measures such as the quality-adjusted life year for every dollar invested	CUA of a pharmaceutical care intervention versus usual care in management of patients with diabetes[8]

Table 4. General Characteristics of Studies.

Study	Method of Economic Evaluation	Setting	Clinical Outcomes	Economic Outcome	Overall Outcome
Wright et al[10]	Cost utility analysis (CUA)	Community	Improvements in patient-reported adherence, use of rescue packs, quality of life, and a reduction in routine general practitioner (GP) visits were identified	Because the intervention was estimated to be associated with a cost saving (from both an NHS and a societal perspective) and a QALY gain, the intervention was estimated to dominate no intervention. According to the CEAC, the estimated probability of the intervention being cost-effective at the λ of £20 000 per QALY was 96.7% and 97.2%, respectively	Results suggest that the service improved patient medicine taking behaviors and that it was cost-effective
Carnevale et al[3]	Cost-benefit analysis (CBA)	Hospital	At 6 months, the intervention group contained higher percentages of patients without coinfections and of patients with CD4+ >500 cells/mm^3. None of the differences between intervention and control groups considering clinical outcomes and costs were statistically significant. However, at 1 year, the intervention group showed a higher percentage of better clinical outcomes	The care program generated lower spending (not to procedures). An additional health care system daily investment of US$1.45, 1.09, 2.13, 4.35, 1.09, and 0.87 would be required for each additional outcome of viral load <50 copies/mL, absence of coinfection, CD4+ >200, 350, and 500 cells/mm^3, and optimal immune response, respectively	The clinical outcomes and the costs did not have statistical difference but showed higher percentage of better clinical outcomes and lower costs for some items
Elliott et al[11]	CUA	Community	The Pharmacist-Led Information Technology–Based Intervention (PINCER) was significantly more effective in reducing medication errors in general practices than providing simple feedback on errors	The PINCER intervention generated £2679 less cost and £0.81 more QALYs per practice (incremental cost-effectiveness ratio [ICER]: −£3037 per QALY) in the deterministic analysis. At a ceiling "willingness-to-pay" of £20 000/QALY (NICE), PINCER reaches 59% probability of being cost-effective	PINCER produced marginal health gain at slightly reduced overall cost. Results are uncertain because of the poor quality of data to inform the effect of avoiding errors
Hendrie et al[5]	Cost-effectiveness analysis (CEA)	Community	Significantly greater reductions in number of hyperglycemic and hypoglycemic episodes occurred in the intervention relative to the control group, respectively, with a net reduction of 1.86 days with glycemic episodes per patient per month	The cost-effectiveness of DMEP relative to standard pharmacy care was AU$43 (US$39) per day of glycemic symptoms avoided. Patients with type 2 diabetes in 3 surveys were willing to pay an average of 1.9 times that amount to avoid a hypoglycemic day	DMEP decreased days with glycemic symptoms at a reasonable cost
Bojke et al[12]	CUA	Community	The intervention led to an average improvement of 0.019 QALYs	The incremental cost per additional QALY was estimated at £10 000. In making decisions about value for money of treatments, NICE generally uses a threshold of between £20 000 and £30 000 per QALY.[4] This suggests that, on average, pharmaceutical care is cost-effective. However, the uncertainty in differential costs and QALYs means that the probability of the intervention being cost-effective is between 78% and 81% for this threshold range	Although pharmaceutical care is estimated to be cost-effective in the UK, the results are uncertain, and further research into its long-term benefits may be worthwhile
Khdour et al[8]	CUA	Hospital	Statistically significantly lower unscheduled GP visits, emergency department (ED) visits, hospital bed days (60% less in the intervention group), and oral steroid and antibiotic courses were observed in the intervention group compared with usual care over the 12-month study period	The mean differences in costs and effects between the self-management and education program and usual care were −£671.59 and £0.065. Thus, the intervention was the dominant strategy because it was both less costly and more effective than usual care. The probability of the intervention being cost-effective was 95% at a threshold of £20 000/QALY gained	The self-management and education program was found to be highly cost-effective compared with usual care

(continued)

Table 4. (continued)

Study	Method of Economic Evaluation	Setting	Clinical Outcomes	Economic Outcome	Overall Outcome
Rubio-Valera et al[13]	CUA	Community	No statistically significant differences were observed between groups in clinical outcomes	From a societal perspective, the ICER for the community pharmacist intervention compared with usual care was €1866 for extra adherent patients and €9872 per extra QALY. In terms of remission of depressive symptoms, usual care dominated the community pharmacist intervention. If willingness to pay was £30000 per extra adherent patient, remission of symptoms, or QALYs, the probability of the community pharmacist intervention being cost-effective was 0.71, 0.46, and 0.75, respectively (societal perspective)	A brief community pharmacist intervention addressed to depressed patients initiating antidepressant treatment showed a probability of being cost-effective of 0.71 and 0.75 in terms of improvement of adherence and QALYs, respectively, when compared with usual care. Regular implementation of the community pharmacist intervention is not recommended
Perraudin et al[14]	CUA	Community	Patients with untreated and treated OSAS had utility values of 0.32 and 0.55, respectively; CPAP treatment was associated with an improvement in utility of 0.23	The probabilistic sensitivity analysis showed that the "screening strategy with CP" was dominant in 80% of cases. It was more effective and less costly in 47% of cases and within the cost-effective range (maximum ICER at £6186.67/QALY) in 33% of cases	CP involvement in OSAS screening is a cost-effective strategy. This proposal is consistent with the trend in Europe and the United States to extend the practices and responsibilities of the pharmacist in primary care
Jódar-Sánchez et al[15]	CUA	Community	By the end of the follow-up, both groups had reduced the mean number of prescribed medications they took, although this reduction was greater in the IG (0.28 ± 1.25 drugs; *P*\0.001) than in the CG (0.07 ± 0.95 drugs; *P* = 0.063). Older adults in the IG saw their quality of life improved by 0.0528 ± 0.20 (*P*\0.001). In contrast, the CG experienced a slight reduction in their quality of life: 0.0022 ± 0.24 (*P* = 0.815)	The mean total cost was €977.57 ± 1455.88 for the IG and €1173.44 ± 3671.65 for the CG. To estimate the ICER, we used the costs adjusted for baseline medications and QALYs adjusted for baseline utility score, resulting in a mean incremental total cost of −€250.51 ± 148.61 (95% CI = −541.79 to 40.76) and a mean incremental QALY of 0.0156 ± 0.004 (95% CI = 0.008-0.023)	The MRF service is an effective intervention for optimizing prescribed medication and improving quality of life in older adults with polypharmacy in community pharmacies. The results from the CUA suggest that the MRF service is cost-effective
Adibe et al[6]	CUA	Hospital	The medical and educational content of the training course was rated positively by the 17 physicians and 29 nurses: the majority 38 (82.6%) rated the content as "excellent," and the remaining 8 rated the content as "very good" or "good"; only 3 (6.5%) of them suggested little modifications or changes	The PC intervention led to incremental cost and effect of Nigerian naira (NGN) 10623 ($69) and 0.12 quality-adjusted life-year (QALY) gained, respectively, with an associated incremental cost-utility ratio of NGN 88525 ($571) per QALY gained	The PC intervention was very cost-effective among patients with type 2 diabetes at the NGN 88525 ($571.13) per QALY gained threshold, although considerable uncertainty surrounds these estimates

(continued)

Table 4. (continued)

Study	Method of Economic Evaluation	Setting	Clinical Outcomes	Economic Outcome	Overall Outcome
Obreli-Neto et al[16]	CUA	Community	Every clinical parameter evaluated improved for the pharmaceutical care group, whereas these clinical parameters remained unchanged in the usual care group	No statistically significant difference was found between the intervention and control groups in total direct health care costs ($281.97 ± $49.73 per patient vs $212.28 ± $43.49 per patient, respectively; *P* = 0.089); pharmaceutical care added incremental costs of $69.60 (±$7.90) per patient. The ICER per QALY was $53.50 (95% CI = $51.60-$54.00; monetary amounts are given in US dollars	Whereas pharmaceutical care did not significantly increase total direct health care costs, significantly improved health outcomes were seen. The mean ICER per QALY gained suggests a favorable cost-effectiveness
Borges et al[17]	CEA	Community	A statistically significant reduction in glycosylated hemoglobin (A1C) levels of patients in the PC group was observed; even these patients showed a statistically significant reduction in the prescribed dose of metformin. On the other hand, the only significant result in the control group concerning the parameters presented in Table 2 was the increase in drug prescription	The pharmaceutical care group had a statistically significant reduction in costs of metformin and ED visits and increased costs with their family physicians. On the other hand, the control group had a statistically significant increase of 21.3% in the general costs of treatment and visits. For the control group, there was a statistically significant increase in the total cost of treatment, including drugs and visits. Besides, this group had an increase of 0.7% in A1C levels, and there was an increase in the general cost of drug treatment and visits of $22.8	The pharmaceutical care group maintained the same costs related to drugs and visits, whereas the control group showed a significant increase in general costs
Claus et al[9]	CBA	Hospital	In half of the cases, therapy was reinitiated without any further adverse drug event	Cost difference (cost value) between that of the avoided toxicity and that of the intervention, where a positive cost value is cost saving. Per annum, pharmacists performed interventions for valproic acid (n = 18) and digoxin (n = 21); the annual cost value of interventions for valproic acid was €18853.7 with a standard deviation of €15020.6; for digoxin it was €41832.0 ± €15348.5	Interventions that prevent digoxin and valproic acid toxicity were cost-effective in this setting. The routine advice to switch the antibiotic class for every reported penicillin allergy is unlikely to avoid adverse drug events and challenges the cost value of this intervention
Bauld et al[18]	CUA	Community	The proportion of carbon monoxide–validated quitters from both services combined fell from 22.5% at the 4-week follow-up to 3.6% at 52 weeks. The group service achieved a higher quit rate (6.3%) than the pharmacy service (2.8%)	The lifetime analysis resulted in an incremental cost per QALY of £4800 for the group support and £2600 for pharmacy one-to-one counseling. The group service was more intensive and required greater overhead costs	Despite disappointing 1-year quit rates, both services were considered to be highly cost-effective

Abbreviations: CEAC, cost effectiveness acceptability curve; CG, control group; CP, clinical pharmacist; CPAP, continuous positive airway pressure; DMEP, diabetes management education programme; IG, intervention group; MRF, medication review with follow up; NHS, National Health Service; NICE, UK National Institute of Clinical Excellence; OSAS, obstructive sleep apnea; PC, pharmaceutical care group; QALY, quality-adjusted life year.

Clinical Outcomes and Cost-effectiveness of Community and Hospital Pharmacy Services

Clinical outcomes and economic effectiveness of pharmacy services were assessed by including the following inclusion/exclusion criteria: clinical benefits of community and hospital pharmacy services included but were not limited to improvements in patient health outcomes (eg, reductions in the number of hyperglycemic and hypoglycemic episodes in type 2 diabetes patients); reductions in unscheduled general practitioner (GP) visits, emergency department (ED) visits, hospital bed days, medication errors, and adverse events; and increases in health-related quality of life (HRQOL) for patients.[3,5,6,8-18] Many studies suggested that hospital and community pharmacy services were economically effective and/or cost-effective and that pharmacy service programs were likely to be considered (cost)-effective when considered against the usual method of care.[3,5,6,8,10,12,14-18]

Hospital Pharmacy Services. Four studies provided an economic evaluation of hospital pharmacy services. These studies focused on the utilization of a clinical pharmacist on broad health care teams or pharmacists providing education regarding medications and self-care.[3,6,8,9] Carnevale et al[3] conducted a CBA investigating the clinical and economic impact of pharmaceutical care of HIV-infected patients in a Sao Paulo Hospital. They found that at a 6-month period, the intervention group contained higher percentages of patients without coinfections and patients with CD4 cell counts of greater than 500 cells/mm^3. The care program generated a benefit of $2.51 per day for every $1.00 spent.[3] Another study by Khdour et al[8] undertook a CUA of a pharmacy-led self-management program for patients with chronic obstructive pulmonary disorder (COPD). Statistically significantly lower ED visits, hospital bed days (60% less in the intervention group), and oral steroid and antibiotic courses were observed within the intervention group as compared with the control group receiving usual care. An ICER of £3278 per quality-adjusted life year (QALY) was generated, with a 95% probability of being cost-effective at a threshold of £20 000 per QALY gained.

Adibe et al[6] conducted a CUA of pharmaceutical care intervention versus usual care in the management of patients with type 2 diabetes. It was discovered that the medical and educational content of the training course was rated positively by the 17 physicians and 29 nurses. Moreover, the pharmaceutical care intervention led to incremental cost and effect of Nigerian naira (NGN) 10 623 ($69) and 0.12 QALYs gained, respectively, with an associated incremental cost-utility ratio of NGN 88 525 ($571) per QALY gained. At the NGN per QALY gain threshold of NGN 88 525 or ($571.13) per QALY, the hospital pharmacy service intervention was considered cost-effective.[6] Finally, Claus et al[9] piloted a CBA of pharmacist-led interventions at a university hospital where pharmacists provided bedside therapy recommendations. Cost difference between avoided toxicity and that of the intervention was the main outcome measure, where a positive cost value (in terms of costs saving) was observed. The pharmacist interventions remained cost-effective after correcting for toxicity.[9] We recognized that hospital pharmacy services and interventions provided several clinical benefits, particularly in improvements in patient health outcomes and a reduction in adverse medication use, and that all studies were considered cost-effective as a result of meeting a cost-utility (per QALY) threshold or were acknowledged as cost saving. Pharmacy services in hospital settings constitute educating prescribers around medication use and pharmacotherapy as well as providing education regarding medicine use in patients.[3,6,8,9]

Community Pharmacy Services. The 10 remaining studies in this review undertook economic evaluations of community pharmacy services. These studies most often involved pharmacists providing medication or disease-specific education, medication management programs, medication review, or follow-up support.[5,10-18] Moreover, these studies tended to be multicentered and included larger numbers of patients. Out of 10 studies, 8 utilized CUAs, whereas the other 2 studies utilized CEAs in their evaluations of these pharmacy services. A shift in economic evaluation methods from CEAs to CUAs in economic evaluations of health care was noted in this review. Many studies indicated the relative economic effectiveness of community pharmacy services. Wright et al[10] evaluated the effect of a community pharmacy–based COPD service on patient outcomes. The study involved a pharmacist led intervention where a pharmacist discussed an initial COPD assessment with patients who smoked and provided medication counseling, lifestyle advice, information regarding a stop smoking service, and a referral letter to the patient's GP to obtain a COPD rescue pack.[10] Patients reported improvements in adherence, use of rescue packs, and quality of life and reductions in GP visits. The intervention was estimated to be cost saving and to include a QALY gain, to dominate no pharmacist intervention, and to be 96.7% cost-effective at the threshold of £20 000 per QALY.[10]

Another study by Bojke et al[12] evaluated the cost-effectiveness of community pharmacy services and pharmaceutical care for older people as compared with usual care in the United Kingdom. Bojke et al revealed that these services and care led to an average improvement of 0.019 QALYs, and an incremental cost per QALY was calculated at £10 000 per QALY. At a cost-effectiveness threshold of £20 000 to £30 000, community pharmacy services and pharmaceutical care was estimated to be cost-effective in the United Kingdom; however, further research was suggested.[12] Jódar-Sánchez et al[15] estimated the incremental cost-effectiveness

ratio (ICER) of a pharmacist-led medication review with follow-up service for older adults with polypharmacy against the standard of usual care. At the end of follow-up, both groups had reduced the number of mean prescribed medications they received; however, this number was higher in the intervention group. Moreover, quality-of-life improvements were seen in the intervention group of 0.0528 ± 20, whereas the control group experienced a slight quality-of-life reduction 0.0022 ± 0.24. The mean incremental, total cost of the service was €250.51 ± 148.61, and the mean incremental QALY was 0.0156 ± 0.004, suggesting that the service was cost-effective.[15]

Obreli-Neto et al[16] evaluated the economic cost and ICER per QALY while evaluating pharmaceutical care in the management of diabetes and hypertension in elderly patients. The service involved pharmaceutical care in addition to usual care whereby individual pharmacotherapy follow-ups and educational group activities were provided by pharmacists to patients. The researchers reported that clinical parameters improved in the group receiving pharmaceutical care, whereas these parameters remained unchanged in the control group. Moreover, the ICER per QALY of the service was US$53.50, with this mean ICER suggesting a favorable cost-effectiveness.[16] Bauld et al[18] conducted a CUA for smokers accessing group-based and pharmacist-led smoking cessation services. The group service involved 7 weeks of group-based support, whereas the pharmacist-led service involved one-on-one counseling with pharmacists. The proportion of carbon monoxide–validated quitters from both services fell from 22.5% to 3.6% at the 4- and 52-week follow-ups, respectively. The group services achieved a higher quit rate than the pharmacy service. However, the ICER per QALY for the group service was £4800, whereas it was £2600 for the pharmacy service because of higher overhead costs for the group service. Both services were considered highly cost-effective.[18]

Additional studies reported similar findings of community pharmacy service economic effectiveness and improvements in clinical outcomes.[5,11,14,15,17] Two examples were Elliott et al[11] and Perraudin et al.[14] Elliott et al conducted a CUA of a Pharmacist-Led Information Technology Based Intervention (PINCER) to reduce rates of clinically important errors in medicines management. The analysis discovered that PINCER was considerably more effective in reducing errors in medications management than simple feedback on errors in general practices. The intervention also generated £2679 less costs and 0.81 more QALYs per practice, with an ICER per QALY of £3037. Elliot and colleagues noted that at a willingness to pay of £20 000, the intervention reaches 59% probability of being cost-effective.[11] Perraudin et al[14] undertook a CUA of a community pharmacist–led sleep apnea screening service. A screening strategy with a community pharmacist was evaluated for cost-effectiveness. The screening strategy with community pharmacists was dominant in 80% of cases and was more effective and less costly in 47% of cares. An ICER of £6186.67 per QALY was reported in 33% of cases, and the intervention was considered cost-effective.[14]

Some studies of community pharmacy services included in this review did, however, report minimal economic and/or cost-effectiveness. Rubio-Valera et al[13] explored the cost-effectiveness of a community pharmacist intervention service in patients with depression. The community pharmacist intervention was compared with usual care and involved an educational program provided by pharmacists to improve patient knowledge regarding antidepressant medicines as well as compliance and adverse effect advice. The study noted that no statistically significant differences were seen between groups in clinical outcomes, and the probability of the service being cost-effective was 0.71 and 0.75 in terms of improvements of adherence and QALYs (at a willingness to pay of £30 000); it also noted that regular implementation of the service was not recommended.[13]

We recognized that community pharmacy services were considered relatively cost-effective in 8 out of 10 studies. These services illustrated several and significant benefits in clinical outcomes and patient quality of life, improvements in patient medicine taking practices and adherence, and increased clinical education provided to patients regarding medicine use.[5,10-18] Economic evaluations of community pharmacy services, much like hospital services, were most often conducted through CUAs and most often reported cost-effectiveness relative to a threshold value between £20 000 and £30 000. This is per the recommendations of the UK National Institute of Clinical Excellence (NICE). Of 10 evaluations of community pharmacy services, 9 reported cost-effectiveness, most often utilizing ICERs (cost per QALY) in this analysis. We, thus, noted that community pharmacy services appear to illustrate minor to significant clinical benefits and cost-effectiveness in this review.

Discussion

This article reports a systematic literature review of the current literature from 2010 to 2015 on the international body of literature concerning various methods of health-economic evaluations used in hospital- and community-based studies of pharmacy service as well as their clinical outcomes and cost-effectiveness. Studies included in this review utilized 3 main methodologies of economic evaluation—CBA, CEA, and CUA—and no study based on CMA was found in this review. CMA as a method of economic evaluation is becoming less common because the method assumes identical benefits for both interventions and services (ie, usual care vs pharmacy services/care) and is most likely to be utilized in in-house projects within hospitals or community pharmacy organizations.[2,4] The limited use of CBAs when compared with cost-effectiveness and more

explicitly, CUAs, is likely a result of the technical challenges in quantifying the cost of clinical benefits, risks, and outcomes.[2] However, it should be noted that with the rise of the willingness to pay method, this analysis is being increasingly used.

We noted that the use of CUA was most common[6,8,10-16,18] when compared with CBAs[3,9] and CEAs.[5,17] CUA is commonly considered to be a variant of general CEA, which utilizes assessment of the quality of life years gained as a measure of benefit, not merely the number of life years or a single disease outcome, as well as allowing comparisons with multiple, as well as differing, health problems within the study.[2,4,6] In addition, CUAs allow comparisons across studies. They also allow evaluation between services on their relative cost-effectiveness when compared with one another.[2,4,6] In the literature, CUAs commonly reported ICERs where the cost per QALY was reported and compared with a threshold to determine the cost-effectiveness of the service. The most commonly reported threshold was a threshold value between £20 000 and £30 000 per the recommendations of the NICE, but it can vary by country. There are concerns in the literature that the use of an ICER may limit the availability of treatments or interventions to patients who do not meet this ratio. This is experienced in cases such as orphan medicines for rare diseases, which often do not provide a high ICER because of the small patient market.[1,2]

Hospital and community pharmacy services were considered by the majority of studies to indicate minor to significant clinical benefits and to be cost-effective. Hospital pharmacy services most often included the pharmacist acting as part of a general health team and providing education to physicians and nurses regarding medicine use, education around medicines to patients, avoidance of adverse events, and outcomes through the checking of pharmaceutical care plans. Pharmacists also provided therapy recommendations in some cases.

Economic evaluations of hospital pharmacy services were generally conducted to assess and to justify the inclusion of a clinical pharmacist as part of these teams or in providing independent education and advice.[3,6,8,9] All hospital studies indicated that hospital pharmacy services were generally cost-effective and provided several clinical benefits, including reductions in adverse events and improvements in patient (health-related) quality of life.[3,6,8,9] Community pharmacy services and pharmaceutical care most often included pharmacist-led services, where pharmacists provided medication or disease-specific education to patients and GPs, medication management programs, review of physician-implemented medicine plans, or follow-up support for patients with regard to medicine use.[5,10-18] Studies assessing the cost-effectiveness of these services utilizing economic evaluation analyses were most often implemented to assess the clinical benefit and cost-effectiveness of pharmacist-led services and programs in the community when compared with the usual standard of care. Nearly all studies indicated clinical benefit, including medication adherence, reductions in the number of unnecessary medication prescriptions and use, improvements in smoking cessation rates, reduction in errors in medication management, improvements in multiple disease-specific clinical parameters, and improvement in general patient (health-related) quality of life.[5,10-18]

We saw a wide range of countries conducting economic evaluations of community and pharmacy services. These countries included the United Kingdom,[8,10-12,18] Australia,[5] Brazil,[3,16,17] Spain,[13,15] France,[14] Nigeria,[6] and Belgium.[9] Interestingly, methods of economic evaluation worldwide were similar, with most studies, regardless of country, utilizing CUAs and evaluating cost-effectiveness based on NICE-directed or general cost-effectiveness ICER per QALY thresholds. We consider that a consensus in the literature on applicable methodologies for conducting economic evaluations of health care interventions may have played a role in this similarity. In particular, the introduction of the Consolidated Health Economic Evaluation Reporting Standards (CHEERS), a 24-item checklist to improve reporting of economic evaluations by the international society for Pharmacoeconomics and Outcomes Research (ISPOR), may have also played a role in this similarity in the methods of economic evaluation worldwide.[19] CHEERS was published in 2013 and is endorsed by a variety of health and health economics journals including *BMJ, Pharmacoeconomics, Value Health*, and *European Journal of Health Economics*, among others.[19] The impact of economic evaluation in global health care practice has enabled the development and use of the scientific discipline of health economics to value hospital and pharmacy services and base funding decisions on objective data.[2] Promising results regarding the cost-effectiveness of hospital and pharmacy services in this review may reflect the need for consensus regarding methodologies of economic evaluations of these services as well as an increasing need for economic evaluation of these services to indicate their cost-effectiveness to policy makers.

Existing reviews in this field predominantly summarized studies undertaking economic evaluation of clinical pharmacy services and interventions and not those of community studies or only provided a discussion of the economic methods utilized. Our review provides important insights regarding the clinical benefit of hospital- and community-based pharmacy services as well as their value for money, with particular consideration of studies published in the past 5 years, whereas many other reviews have considered the literature up to the year 2010. Our study has several limitations. First, outcome reporting bias and/or publication bias may have led to publication or nonpublication of studies depending on their reported findings.[1] Second, researchers only included studies in the English language, and we only included peer-reviewed articles; gray literature was

excluded. This step was undertaken to ensure academic accuracy; however, we may have missed several important reports or economic evaluations conducted by organizations such as Ministries of Health or NICE that have reported on the cost-effectiveness of hospital or community pharmacy services. Future research on economic evaluations of hospital and community pharmacy services is needed to increase the relatively limited available literature on the topic. This will enable an understanding of which health care services provide value for money and also inform policy makers as to which services will be cost-effective in light of limited health care resources.

Conclusion

Economic evaluations of hospital and community pharmacy services are becoming increasingly commonplace to enable an understanding of which health care services provide value for money and to inform policy makers as to which services will be cost-effective in light of limited health care resources. CUAs as opposed to CMAs, CBAs, or general CEAs are becoming increasingly common and are the most utilized methodology per study results. Hospital and community pharmacy services provided several important clinical benefits, including increased medication adherence, reductions in adverse events, and improvements in patient quality of life.

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