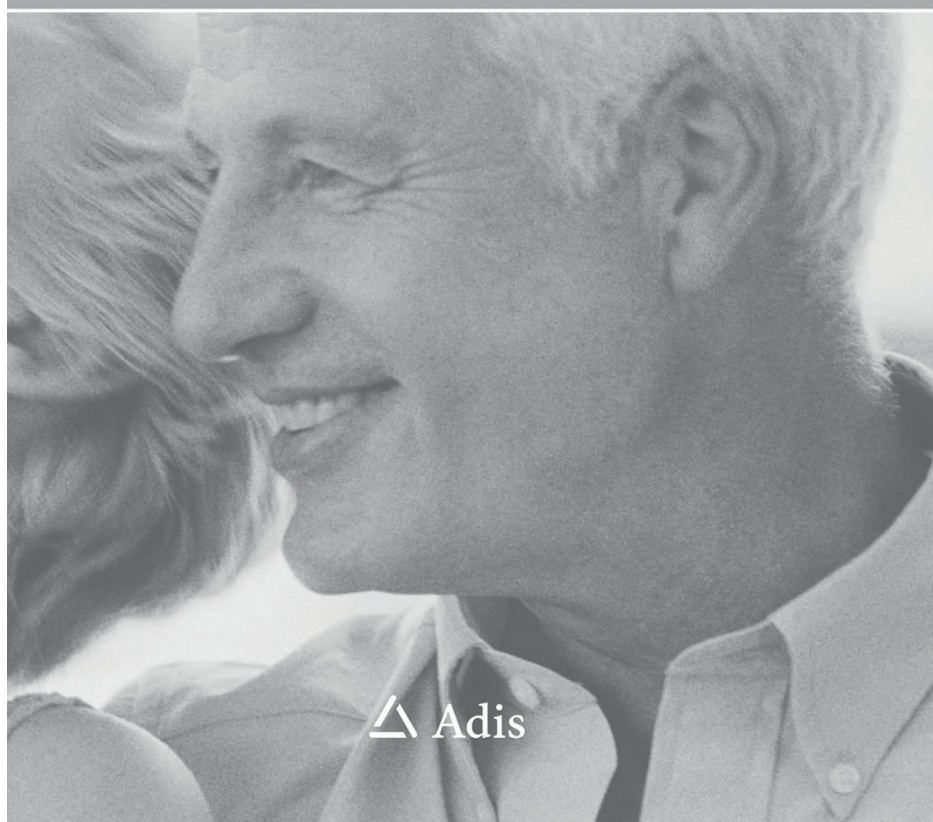


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The Role of the Pharmacist in Optimizing Pharmacotherapy in Older People

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Abstract

Prescription of medicines is a fundamental component of the care of older people, but evidence suggests that pharmacotherapy in this population is often inappropriate. Pharmacists have been involved in different approaches for the optimization of prescribing and rational medication use in older people. This article describes the different models of care in which pharmacists are involved in the optimization of pharmacotherapy in older people, and reviews the impact of these approaches on both process and outcome measures. The provision of pharmaceutical care, medication reviews and educational interventions by pharmacists in the nursing home, ambulatory and acute care settings are discussed. We selected systematic reviews, reviews and original studies, and for the latter, we focused more specifically on European publications published between 2001 and 2011.

From the literature reviewed, it is clear that when pharmacists play a proactive role in performing medication reviews and in the active education

of other healthcare professionals, pharmacotherapy for older patients is improved. However, the evidence of the impact of pharmacists' interventions on health outcomes, quality of life or cost effectiveness of care is mixed. Better results have been reported when pharmacists are skilled and work in the context of a multidisciplinary team. Opportunities remain for multicentre, European-based, pharmacist-intervention trials in all settings, to determine the effectiveness and economic benefit of pharmacist involvement in the optimization of pharmacotherapy in older people.

1. Introduction

The prescription of medicines is a fundamental component of the care for older people, but evidence suggests that the use of medicines in this population is often inappropriate for many different reasons, such as complexities of prescribing and patient and health system factors.^[1] This in turn can have deleterious effects such as adverse drug events (ADEs) and a subsequent increase in the utilization of healthcare services, and costs.^[2] According to published studies, 10–30% of hospital admissions in older people are directly related to drug-related problems (DRPs),^[3–5] and ADEs are documented in 5–35% of older patients in the community and lead to hospital admissions in 6–16% of cases.^[6] Furthermore, a substantial percentage of ADEs (32–69%) are possibly preventable.^[7]

Different types of interventions to optimize pharmacotherapy in older people have been described and evaluated. They include educational approaches, medication reviews, computerized decision support systems, multidisciplinary team interventions, geriatric evaluation and management teams, and pharmacist interventions.^[1] Pharmacists have been the leaders of or participants in many of these approaches.

The terms that are most commonly used to describe pharmacists' involvement in patient care are 'clinical pharmacy' or 'pharmaceutical care'. The philosophy of pharmaceutical care is based around a process by which a pharmacist liaises with a patient and/or other healthcare professional (HCP) to optimize pharmacotherapy, by designing, implementing and monitoring therapeutic goals that will produce specific therapeutic outcomes for patients. It involves the identification, resolution and prevention of potential and actual DRPs.^[8]

Adopting a patient-centred approach is fundamental to the philosophy of pharmaceutical care.

In parallel, medication reviews conducted by pharmacists have been widely described in the literature and vary from (i) pharmacists independently reviewing a patient's list of medicines to (ii) discussing each and every medicine with the patient to (iii) reviewing a patient's clinical medical notes along with reviewing their medicines and discussing the outcomes of these reviews with the patient and/or with the patient's physician. Hughes and Lapane^[9] recently defined a medication review as "a review performed by a healthcare professional, taking into consideration a patient's health status and medications, with access to full medical and care records, in conjunction with a consultation with the patient and their carer." Pharmacist-led medication reviews have formed the basis of a number of intervention studies in the UK, Sweden, Switzerland, Norway, Netherlands, US and Australia.

The objectives of the present review were (i) to describe the different models of care in which pharmacists were involved in optimizing pharmacotherapy for older people; and (ii) to review the impact of these approaches on both process and outcome measures, with a focus on recent European trials.

2. Search Methodology and Study Inclusion

Relevant papers were identified from previous reviews performed by the authors, complemented by a manual and electronic search of papers published in 2010 and 2011 (up to July 2011) in peer-reviewed geriatrics journals (*Drugs & Aging*, *Age and Aging*, *Journal of the American Geriatrics Society*, *American Journal of Geriatric Pharma-*

cotherapy, *BMC Geriatrics*, *European Geriatric Medicine* – this selection was made for relevance and feasibility reasons). We selected systematic reviews, reviews and original research that addressed the role of pharmacists in the optimization of pharmacotherapy for older people. For original studies, we mainly selected from recent European publications (2001–11), as well as other highly regarded studies, namely studies that have been used and referred to by many European researchers. The reference list of each relevant study identified was also examined to identify any additional studies.

Table I summarizes randomized controlled trials (RCTs) that have been performed in European countries over the last 10 years pertaining to pharmacy services and their impact on pharmacotherapy for older people. These trials are further discussed in the text below, together with other observational studies performed in Europe. The findings are summarized by setting of care. Table II gives an overview of reviews and systematic reviews published over the last 5 years that have evaluated the impact of pharmacy services on pharmacotherapy for older people.

3. Role and Impact of the Pharmacist in the Nursing Home Setting

Several recent systematic reviews of pharmacists' interventions in nursing home patients remarked on the varied roles of the pharmacist within the long-term care/nursing home setting, such as (i) performing regular medication reviews; (ii) being an active member of a multidisciplinary team; and/or (iii) enhancing the knowledge of physicians, nurses and patients with regard to safer medication usage. These reviews generally concluded that the available evidence is mixed concerning the impact of interventions by pharmacists in the nursing home setting.^[29,31,33–35]

3.1 Medication Reviews Performed by Pharmacists

Zermansky et al.^[10] reported on the impact of pharmacist-led medication reviews compared with reviews carried out by general practitioners

(GPs) in 661 nursing home residents in the UK. The reviews that were carried out by the pharmacists resulted in statistically more changes per patient medication regimen than those performed by GPs; however, the changes that were actually accepted by the patient's physicians (77%) did not result in statistically significant reductions in either drug costs or rate of hospitalizations. A more recent observational study conducted in the Netherlands demonstrated statistically significant reductions in DRPs following the implementation of pharmacist-led reviews in 30 patients.^[36] Furniss et al.^[37] published the results of an RCT carried out in 14 nursing homes in England, using a similar intervention to Zermansky et al.^[10] Their findings were inconclusive, as a reduction in both the number and costs of medicines was not statistically significant between the two arms. They also found no difference in the secondary outcome measures, such as GP visits and hospitalizations.

Studies have also reported on the role of a pharmacist as part of a larger multidisciplinary team conducting medication reviews. Schmidt et al.^[38] reported on the findings of pharmacists' interventions in 33 nursing homes in Sweden. The study involved doctors, pharmacists, nurses and nursing assistants working together as part of a multidisciplinary team. The intervention aimed to reduce the rate of inappropriate prescribing of psychoactive medications such as antipsychotics, hypnotics and anxiolytics. The intervention involved case conferences discussing the prescribing of such medications. The results from the homes that were randomized to the intervention showed that the mean numbers of psychoactive medications and therapeutic duplications did not change over time, although there was a reduction in the prescribing of antipsychotics, hypnotics and antidepressants. During the same period, the prescribing of psychoactive medications and therapeutic duplications increased in the nursing homes allocated to normal care. The authors concluded that the multidisciplinary nature of the intervention was key to the success of this intervention.^[38,39]

More recently, Halvorsen et al.^[40] published the findings of a multidisciplinary intervention with regard to resolving DRPs in Norwegian nursing homes. The intervention consisted of a pharmacist

Table 1. Selection of randomized controlled trials performed in Europe and published over the last 10 years that evaluated the impact of pharmacists in optimizing prescribing in older people in various settings, as indicated

Study (year)	Population	Intervention	Duration	Main results
Nursing home setting				
Zermansky et al. ^[10] (2006)	661 residents taking ≥1 drug in 65 NHs, UK	Medication review associated with consultations with patient and carer; written recommendations forwarded to GP	6 mo	P: 76% acceptance rate and 77% of these were implemented O: no significant difference in number of hospitalizations and number and cost of drugs
Patterson et al. ^[11] (2010)	334 residents in 22 NHs, UK	Medication review by trained pharmacists monthly for 12 mo; application of an algorithm regarding psychoactive medication in consultation with GP	12 mo	P: reduction in the number of residents taking psychoactive agents at the end of 12 mo O: no difference in the rate of falls between the 2 groups
Ambulatory care setting				
<i>Interventions by community pharmacists in the community pharmacy setting</i>				
Bernsten et al. ^[12] (2001) and Sturgess et al. ^[13] (2003)	2454 patients aged ≥65 y, taking >4 medications, in 190 community pharmacies in 7 European countries (Northern Ireland, Germany, Denmark, Netherlands, Portugal, Sweden and the Republic of Ireland)	Harmonized, structured pharmaceutical care programme: patients' education, compliance strategies, optimization of drug regimens, drug therapy monitoring	18 mo	P: no differences in knowledge (improvement in some countries), compliance, number of prescription and nonprescription medications and drug-therapy changes O: decline in HR-QOL (SF-36) in the pooled data (improvements in some countries), no difference in hospitalizations and associated costs in the pooled data (cost savings in some countries)
Denneboom et al. ^[14] (2007)	738 patients aged ≥75 y, taking >5 drugs; 28 community pharmacies, 77 GPs, Netherlands	Treatment reviews using patients' pharmacy records and computerized screening tools; recommendations to GPs via written reports (group I) or using case-conference approach (group II)	9 mo	P: more medication changes accepted by GPs in the case-conference group at baseline and after 6 mo (p = 0.02), no difference after 9 mo (p = 0.07) O: higher costs in the case-conference group were covered by slightly greater savings
RESPECT trial ^[15,16] (2010)	760 patients (551 completed), aged ≥75 y, ≥5 repeat drugs; 62 community pharmacies, 24 general practices (5 primary care trusts), UK	Shared pharmaceutical care for older people (GPs and community pharmacists); home visits by community pharmacists aimed at medication adherence and knowledge about medications	3 y (12 mo of pharmaceutical care)	P: no significant impact on UK-MAI score O: no significant impact on number of hospital admissions or other episodes of secondary care; reduced SF-36 physical and mental scores; some evidence of cost effectiveness, but lack of significance

Continued next page

Table 1. Contd

Study (year)	Population	Intervention	Duration	Main results
Home medicines reviews				
Kraska et al. ^[17] (2001)	332 patients aged ≥65 y with ≥2 chronic diseases and taking ≥4 drugs in 6 general practices, Scotland	Pharmacist review of drugs and related issues (in-home interviews; medical records review); recommendations agreed to by patient's GP	3 mo	P: increased resolution of pharmaceutical care issues 83% vs 41%, p<0.001 O: no difference in medication costs, HR-QOL, utilization of health and social services O: higher rate of hospital readmissions (hazard ratio=1.30; 95% CI 1.07, 1.58); no significant improvement in QOL or mortality P: decrease in the mean number of prescribed drugs (-0.87 items; p=0.03) O: no difference in hospital admission, care home admissions and deaths
Holland et al. ^[18] (2005)	872 patients aged ≥80 y discharged from hospital, taking ≥2 drugs daily on discharge, UK	Home-based medication review by pharmacist; 2 visits 2 and 8 wk after discharge	6 mo	
Lenaghan et al. ^[19] (2007)	136 patients aged >80 y, taking ≥4 drugs and with ≥1 drug-related risk factor; 1 general practice, UK	Home-based medication review; 2 home visits by 1 experienced community pharmacist; recommendations agreed to by patients' GP	6 mo	
Clinical pharmacy interventions in the clinic-based setting				
Zermansky et al. ^[20] (2001)	1188 community-living patients aged ≥65 y, taking ≥1 repeat medication in 4 general practices, UK	Clinical medication review of repeat prescriptions by a skilled pharmacist in general practices against normal general practice review	12 mo	P: more changes in repeat prescriptions (2.2 vs 1.9 per patient; p=0.02) O: lower monthly drug costs per patient (mean difference £61 per year); no difference in the number of practice and outpatient consultations, hospital admissions and mortality
Acute care setting				
Spinewine et al. ^[21] (2007)	203 patients admitted to an acute care of the elderly ward, Belgium	Pharmaceutical care provided from admission to discharge	12 mo	P: significant improvements in appropriateness of prescribing (MAI and underuse ACOVE criteria), no significant difference in Beers criteria O: non-significant decrease in mortality and emergency visits 12 mo after discharge; no effect on readmission
Gillespie et al. ^[22] (2009)	400 patients aged ≥80 y, admitted on an acute internal medicine ward, Sweden	Pharmaceutical care provided from admission to discharge, plus follow-up calls after discharge	12 mo	O: 16% reduction of hospital visits, 46% reduction in emergency department visits, 80% reduction in drug-related readmissions (statistically significant)

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Table 1. Contd

Study (year)	Population	Intervention	Duration	Main results
Hellstrom et al. ^[23] (2011)	210 patients aged ≥65 y, admitted to 3 internal medicines wards, Sweden	Medication reconciliation on admission and at discharge, medication review and monitoring, provided by a clinical pharmacist in a multidisciplinary team	3 mo	P: decreased number of inappropriate drugs (using MAI) in intervention group ($p < 0.05$) O: lower risk of drug-related readmission in intervention group ($p < 0.05$) O: no difference in length of stay, mortality, readmission, quality of life, contact with primary healthcare
Lisby et al. ^[24] (2010)	100 patients aged ≥70 y, taking ≥1 drug, admitted on an acute internal medicine ward, Denmark	Medication histories by a clinical pharmacist followed by discussion of treatment with a clinical pharmacologist	3 mo	O: no difference in hospital readmission, medication knowledge and adherence, general well-being and satisfaction
Transition across settings of care				
Nazareth et al. ^[25] (2001)	362 patients aged ≥75 y, discharged from 3 acute general and 1 long-stay hospital, on ≥4 medicines, UK	Pharmaceutical discharge plan given to patient, caregivers and professionals; home visit by a community pharmacist 1–2 wk after discharge	6 mo	P: better knowledge and compliance O: decreased unplanned visits to the GP and readmission to hospital ($p < 0.05$)
Al-Rashed et al. ^[26] (2002)	83 elderly patients on 2 care of the elderly wards and discharged home on ≥4 drugs, with medication problems, UK	Predischarge pharmaceutical counselling	3 mo	O: no difference in hospital readmission, medication knowledge and adherence, general well-being and satisfaction

ACOVE = Assessing Care of the Vulnerable Elder; GP = general practitioner; HR-QOL = health-related quality of life; MAI = Medication Appropriateness Index; NHs = nursing homes; O = outcome measure (clinical, economic and/or humanistic); P = process measure; QOL = quality of life; SF-36 = Short-Form 36 Health Survey.

attending regular pre-round case conferences, after having conducted systematic medication reviews for each resident of the nursing homes. During the case conference, the pharmacists identified and discussed DRPs with both medical and nursing staff, upon which 94% of the interventions were accepted and modified for the patients concerned. Similarly, a study carried out in Switzerland by Brulhart and Wermeille^[41] identified 1225 DRPs in 329 patients residing in ten nursing homes. The medication reviews conducted by the pharmacists were discussed with physicians and nurses, and 93% of the interventions led to a rapid change in the patients' medication. These studies demonstrated that higher uptake of pharmacists' interventions can be achieved by combining a pharmacist-led medication review with effective communication with other healthcare staff.

Several studies conducted in Europe and beyond have demonstrated the potential benefits of such medication reviews performed by trained clinical pharmacists. These studies support a formalized medication review process, which when conducted as part of a multidisciplinary team, has led to more favourable prescriptions for nursing home patients. Specialist pharmacists working in the US have developed, evaluated and formulized this medication review/intervention reporting process and it is known as the Fleetwood Model of Pharmaceutical Care.

3.1.1 The Fleetwood Model of Pharmaceutical Care

In 1995, the American Society of Consultant Pharmacists launched the Fleetwood Model, an innovative approach to the delivery of pharmaceutical care to older nursing home residents. The term 'consultant pharmacist' is used to depict the role of a pharmacist who primarily focuses on medication review and managing the medication regimens of patients.^[9]

The major components of the Fleetwood Model of Pharmaceutical Care, i.e. the pharmacist intervention, are as follows: (i) conducting a medication review of patients' pharmacotherapy, screening for high-risk medicines/adverse drug reactions and DRP; and (ii) liaising with the prescriber, i.e. communicating to resolve medication-related problems.^[42]

Table II. Recent (systematic) reviews evaluating the impact of pharmacy services on prescribing for older people

Study (year)	Aim	Identification and selection of studies	Studies included	Main findings	Main comments (as stated by the authors)
Reviews that focused on interventions provided by pharmacists (alone or within a multidisciplinary team)					
Holland et al. ^[27] (2008)	To evaluate the effects of medication review by pharmacists on hospital admissions and mortality for older people across all care settings	SR and MA; 11 databases; up to 2005; RCTs	n = 32 (Europe: n = 14 [UK: 13; seven European countries: 1])	No significant effect on all-cause admission (17 studies); no significant benefit on mortality (22 studies)	Lack of direct communication between the pharmacist and the prescriber in half of the studies; no access to medical records for the pharmacist in a third of the studies
Castelino et al. ^[28] (2009)	To review the effects of interventions by pharmacists on suboptimal prescribing in the elderly	Review; 3 databases; 1992–2008; RCTs	n = 11 (Europe: n = 2 [Scotland: 1; Belgium: 1])	Most studies showed significant improvement in suboptimal prescribing at one or more timepoints	More research needed to address the underuse of medications and healthcare impact of reducing suboptimal prescribing
Verrue et al. ^[29] (2009)	To evaluate the effects of interventions involving pharmacists and aiming at improving the quality of prescribing in NHs	SR; 3 databases; 1987–2008; CTs	n = 8 (Europe: n = 3 [Sweden: 1; UK: 2])	Mixed evidence for the effectiveness of various interventions by pharmacists	Several possible reasons for the lack of effect identified (e.g. wrong outcome measure, poor acceptance rate, study underpowered, duration too short)
Zermansky and Silcock ^[30] (2009)	To review clinical trials that seek to measure cost effectiveness of medication review by a pharmacist for older people	Review; 2 databases; up to 2007; no exclusion on study design	n = 16 (Europe: n = 9 [UK: 7; Netherlands: 1; Norway: 1])	Clinical medication review is probably of value and may be cost effective	Large variations in the nature of medication review, population studied, outcome data measured, skills and training of pharmacists
da Silva et al. ^[31] (2010)	To analyse the research quality of pharmaceutical interventions in older residents of long-term care facilities	SR; 4 databases; 1988–2010; no exclusion on study design	n = 7 (Europe: n = 3 [UK: 2; Switzerland: 1])	Various possibilities of pharmaceutical interventions in long-term care facilities and potential benefits	Better results when interventions performed with involvement of the health staff (compared with isolated pharmaceutical services); lack of direct participation of older adults in the intervention process
Reviews that included any type of optimization approach (including approaches involving pharmacists)					
Kaur et al. ^[32] (2009)	To identify interventions and strategies that can significantly reduce inappropriate prescribing in the elderly	SR; 5 databases; up to 2008; no exclusion on study design	n = 24; with pharmacists: n = 15 (Europe: n = 3 [Belgium: 1; Norway: 1; UK: 1])	All studies except one demonstrated that clinical pharmacists can lead to improvement in appropriate prescribing	Heterogeneity in the content of interventions and outcome measures

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Table II. Contd

Study (year)	Aim	Identification and selection of studies	Studies included	Main findings	Main comments (as stated by the authors)
Marcum et al. ^[33] (2010)	To review the published literature describing RCTs that used interventions to improve suboptimal prescribing in NHs	Review; 3 databases; 1975–2009; RCTs	n = 18; with pharmacists: n = 9 (Europe; n = 3 [UK; 2; Sweden: 1])	Mixed results for a variety of approaches used to improve suboptimal prescribing	
Forsetlund et al. ^[34] (2011)	To evaluate the effect of interventions aimed at reducing potentially inappropriate use or prescribing of drugs in NHs	SR; 6 databases; up to April 2010; RCTs	n = 20; with pharmacists: n = 10 (Europe; n = 5 [UK; 3; Sweden: 2])	Medication review with the participation of a clinical pharmacist may have a positive influence on the use of drugs in NHs; evidence varied from low to very low; quality of evidence for health-related outcomes is too low to draw any conclusions	The role of pharmacists varied from doing a limited medication review with a passive response to the doctor, to teaching and coordination and involvement of other HCPs in a multidisciplinary team; impact lower when only written recommendations were provided
Loganathan et al. ^[35] (2011)	To review the effect of interventions to optimize prescribing in care homes	SR; 4 databases; 1990–April 2010; CTs	n = 16; with pharmacists: n = 9 (Europe; n = 4 [UK; 2; Norway: 1; Sweden: 1])	Mixed results; multidisciplinary team meetings as well as staff education involving pharmacists proved successful despite insufficient evidence for pharmacist-led reviews alone	May be partly due to the inappropriate choice of outcome measures

CTs = controlled trials; HCPs = healthcare professionals; MA = meta-analysis; NHs = nursing homes; RCT = randomized controlled trial; SR = systematic review.

In brief, the key findings from the Fleetwood Model studies were that the potential pharmacoeconomic savings from the improved therapeutic outcomes associated with a retrospective medication regimen review conducted by consultant pharmacists could be as high as \$US3.6 billion (1995 year value) annually, resulting from avoided medication-related problems.^[43] Secondly, the implementation of the pharmaceutical care model into the daily work routine of the consultant pharmacists resulted in greater input from the pharmacists into clinical decision making and interventions, and better communication between the pharmacists, the patient and the multidisciplinary team.^[42] Thirdly, the final phase involved a review and an evaluation of the Fleetwood Model of Pharmaceutical Care implemented in 12 nursing homes. Patients were identified as being at high risk of experiencing a DRP on the basis of specific criteria, such as them being on ≥ 3 cardiovascular system medicines, or taking ≥ 7 medicines daily.^[44] Potentially inappropriate prescribing was reported in 27% of residents, and 40% of patients were considered to be at risk of DRPs. Following the application of the Fleetwood Model of Pharmaceutical Care, 55% of the recommendations made by the consultant pharmacists were accepted.^[44]

A group of researchers from the UK have adopted and implemented the Fleetwood Model of Pharmaceutical Care in Northern Ireland. Patterson et al.^[45] carried out a study in 2007, to assess both the applicability and feasibility of a modified Fleetwood Model of Pharmaceutical Care. While the model of care was accepted and welcomed by the majority of HCPs involved in nursing home care, challenges arose when the researchers tried to implement the full Fleetwood Model of Pharmaceutical Care, necessitating a revision of the model for application in UK nursing home populations. A cluster RCT was undertaken in 22 nursing homes across Northern Ireland (intervention, n = 11; control, n = 11).^[11] Pharmacists were trained on the application of the modified Fleetwood Model of Pharmaceutical Care, which focused primarily on psychoactive agents. The pharmacists visited their designated nursing homes on a monthly basis and performed their reviews. They communicated their recommendations to the

GPs responsible for medical care in each nursing home. The primary outcome measure was a reduction in the inappropriate prescribing of psychoactive agents, and after 12 months, a significant reduction was demonstrated between both groups (odds ratio 0.26; 95% CI 0.14, 0.49; $p < 0.001$). The economic impact of this study was evaluated, and it was found that the mean cost of pharmacists performing the intervention was \$US138.68 per resident, but overall, the costs of healthcare resources used during the study in the intervention arm were less than those in the control, i.e. \$US4922.84 versus \$US5053.23 per resident (2006–7 year values).^[46] They concluded by saying that “The probability of the intervention being cost-effective was high, even at low levels of willingness to pay to avoid a resident receiving inappropriately prescribed psychoactive medication.”

3.2 Educational Interventions Performed by Pharmacists

Eide and Schjott^[47] reported on the clinical benefits of providing staff working in Norwegian nursing homes with medicines information pertaining to the administration of hypnotics. The result from this pharmacist-delivered intervention was a reduction in the prescribing and administration of long-acting benzodiazepines; however, in contrast to this finding, an increase in the use of short-acting hypnotics was reported.

A systematic review by Nishtala et al.^[48] with regard to the impact of medication reviews and educational interventions on the prescribing of psychotropic agents in nursing home/long-term care facilities reported a pooled odds ratio from five studies of 0.57 (95% CI 0.41, 0.79), and they concluded by stating that “Medication reviews and/or educational interventions are effective at reducing psychotropic drug prescribing.”

In summary, from the studies identified and described above, enhanced identification and rectification of DRPs for patients residing in long-term care facilities/nursing homes occurred when the pharmacist-led medication reviews were conducted as part of a multidisciplinary team-based approach, i.e. prescribers seem to be more responsive to change from a multidisciplinary team.

4. Role and Impact of the Pharmacist in the Ambulatory Care Setting

In several countries, pharmaceutical care provided to community-residing patients has been specifically mandated or encouraged, e.g. in the US, UK, Canada, Netherlands, Australia and New Zealand. In the UK, for example, the National Service Framework for older people recommends medication reviews to reduce the medicine-related problems encountered by older people.^[49,50] This triggered the development of research projects that aimed to evaluate the impact of these medication reviews. Several of these studies have been published and are discussed below (sections 4.1–4.4).

Two subsequent reviews conducted by Hanlon and colleagues^[2,6] have already discussed the role of pharmacists in optimizing the pharmacotherapy of older people in the ambulatory setting, based on published RCTs. Both reviews found evidence that medication management services and pharmaceutical care services reduce the occurrence of DRPs. Unfortunately, the evidence about the effect of such services on clinical outcomes, health-related quality of life and cost effectiveness was found to be limited.

4.1 Interventions by Community Pharmacists in the Community Pharmacy Setting

Several large intervention studies performed in Europe evaluated the effect of structured pharmaceutical care provided by community pharmacists to older outpatients.

In the PEER study (Pharmaceutical care of the Elderly in Europe Research), Bernstein et al.^[12] evaluated the outcomes of a structured pharmaceutical care programme provided by community pharmacists to older patients taking at least four medications. The trial involved 104 intervention and 86 control pharmacy sites, and 1290 intervention and 1164 control patients from seven European countries. No differences in primary outcomes (health-related quality of life, hospitalizations and associated costs) were found. There were some positive, but not statistically significant, changes in certain process measures in patients in the intervention group. Some health improvements were detected in the intervention

group in several countries, even cost savings.^[13] However, the study had important methodological limitations and intervention pharmacists received only 1 day of training.^[12]

A cluster RCT conducted in community pharmacies in the Netherlands evaluated the impact of community pharmacists' recommendations to GPs about medication management.^[14] The trial involved 28 community pharmacists, 77 GPs (convenience sample) and 738 older people aged ≥ 75 years using more than five medications. Pharmacists evaluated prescribing problems identified by computerized screening tools from patients' pharmacy records. The software highlighted possible medication improvements and the pharmacists had to decide which recommendations should be communicated to the GP. Two intervention groups were evaluated: group I, for whom recommendations to GPs were sent via written report; and group II, in which a case-conference approach was used. Significantly more changes were accepted by GPs in the case-conference group at the baseline period and after 6 months' follow-up ($p=0.02$) with no difference at 9 months. This trial demonstrated that performing medication reviews with case conferences led to greater uptake of clinically relevant recommendations compared with written feedback. The higher costs of the interventions in the case-conference group were covered by slightly greater savings in this group.

The RESPECT trial (Randomised Evaluation of Shared Prescribing for Elderly people in the Community over Time) was another larger trial aimed at evaluating the effectiveness and cost effectiveness of pharmaceutical care provided by 62 community pharmacists to 760 older people in the UK.^[15,16] The results of the RESPECT trial resembled the findings of the PEER study. The intervention did not lead to significant changes in the appropriateness of prescribing or quality of life. The researchers reported that it was often challenging to fully implement pharmaceutical care in the community because of difficulties in collecting and accessing patient data, and to organize meetings to discuss care plans with GPs. Moreover, training was limited to two sessions. Analyses of cost effectiveness led to uncertain results. In the cohort of older patients partici-

pating in the study, pharmaceutical care services were estimated to be cost effective mainly in younger subjects with fewer medications.

4.2 Home Medicines Reviews

Three RCTs performed in the UK have evaluated the effect of home-based structured medication reviews performed by pharmacists.^[17-19]

In the study by Kraska et al.,^[17] clinical pharmacists in Scotland conducted in-home medication reviews (interviews and pharmaceutical care plans) in older adults suffering from two or more chronic disorders and using at least four medications regularly. More DRPs were resolved after a 3-month period in the intervention group compared with in the control group (82.7% vs 41.2%, respectively; $p<0.05$), but no differences between groups were found in patient quality of life or utilization of health services.

The HOMER (Home-based Medication Review) trial was a large RCT that evaluated the effect of two home visits by pharmacists in patients discharged after an unplanned admission to hospital.^[18] Pharmacists evaluated drug adherence. Where appropriate, they educated the patient and carer, removed out-of-date drugs, reported possible drug reactions or interactions to the GP, and reported the need for a compliance aid to the local pharmacist. The primary outcome measure was the rate of emergency readmissions at 6 months, and the authors surprisingly identified an increased risk in the intervention group ($p=0.009$). The authors hypothesize that the results might have occurred secondary to better understanding and help-seeking behaviour, or were due to better patient adherence in the intervention group. Helping older patients adhere to medication regimens can have adverse consequences, especially if some regimens are suboptimal. Other points for concern are that pharmacists did not have access to full patient data, and that communication with GPs was routinely done by letter, with occasional phone calls, but no face-to-face contact.

Finally, in the POLYMED study, one skilled community pharmacist with a postgraduate qualification conducted medication reviews in older

patients over 80 years of age, who were prescribed four or more oral medications and presented with at least one additional risk factor (living alone, confusion in a patient record, impaired vision or hearing, medication-related morbidity, or >7 oral medicines).^[19] The authors found a statistically significant reduction in the mean number of medicines prescribed to the patients after 6 months, but again, no positive effect on health outcomes and quality of life was observed.

4.3 Clinical Pharmacy Interventions in the Clinic-Based Setting

Zermansky et al.^[20] performed an RCT in 1188 older patients using at least one repeat medication in four general practices in Leeds Health Authority (UK) to evaluate the impact of comprehensive medication reviews provided by a specifically trained pharmacist. Clinical medication reviews resulted in more changes in drug regimens compared with usual care (difference=0.31; 95% CI 0.06, 0.57; $p=0.02$). Drug costs and the number of repeat prescriptions rose significantly less in the intervention group, and a reduction in net cost per patient per 28 days was documented (mean difference=−£4.72 per 28 days; 95% CI −7.04, −2.41; study period: June 1999–June 2000). There was no evidence that a review of treatment by the pharmacist affected practice consultation rates, outpatient consultations, hospital admissions or mortality rates. This RCT highlights the benefits of patient-centred, structured medication reviews regarding repeat drug prescription and costs, in community-residing older adults, provided by skilled pharmacists in a close collaboration with GPs, the strategy recommended by the National Service Framework for Older People in the UK.

4.4 Toward More Collaborative Approaches between Pharmacists and Primary Care Teams

In one of the latest reviews of RCTs evaluating the role of medication management services in primary care, the 'primary care medical home model' was recommended among the new models of care.^[51] In this model of care, one primary care

provider, usually the GP, coordinates all services delivered by multiple HCPs to a patient, including medication therapy management provided by pharmacists.^[51] This model enhances the multidisciplinary collaboration of HCPs and enables them to follow the same therapeutic goals for one patient. It gives an opportunity to pharmacists to be directly involved in primary care decisions and to contribute to better medication treatment. Such collaboration eliminates inappropriate, unnecessary or duplicate steps in patient care. This model has already shown improvements in the quality and efficiency of medical care in the community and improvements in preventing, detecting and resolving medication-related problems in the community.^[52,53]

Medication management services in Australia are an example of such collaboration. They have been funded by the Commonwealth Government since 2001. Accredited pharmacists (i.e. pharmacists with education based on theoretical courses, clinical training and open-book, case-based examinations) and GPs are reimbursed for the provision of these services.^[7] GPs usually refer patients, on the basis of eligibility criteria, to the patient's community pharmacy. Pharmacists provide home medicines reviews and prepare a written report for the patient's GP, addressing their findings and recommendations with regard to the medication management of the patient. After the agreement of the GP and patient, a medication management plan is implemented.^[54]

In summary, most studies evaluating the impact of pharmaceutical care services in older patients in the community confirmed that there were improvements in medication management but usually no statistically significant changes in patient health outcomes, quality of life or cost effectiveness of care. This might be due to the methodological limitations (lack of power, short follow-up, etc.), but this also might be due to insufficient training of pharmacists as well as to the position of the pharmacist being too detached from the primary care team.^[55] In addition, the level of medication review varied between studies. Current data suggest that clinical medication reviews by pharmacists are likely to be cost effective, but data are too limited.^[30] Large-scale, long-term,

multicentre, collaborative clinical trials with skilled pharmacists are needed.

5. Role and Impact of the Pharmacist in the Acute Care Setting

The role of clinical pharmacists in acute care has evolved over time, with increased emphasis on collaborative care and patient interaction.^[56] A systematic review found that interacting with the healthcare team on patient rounds, interviewing patients, reconciling medications, and providing patient discharge counselling and follow-up all resulted in improved outcomes such as ADEs, medication errors, medication knowledge and length of stay.^[56]

There is a lot of inter- and intra-country variability in the practice of clinical pharmacy worldwide, including within Europe. Different surveys have been performed to describe the level of implementation of clinical services by pharmacists in the acute care setting. However, to our knowledge, there are only very scarce data specifically reporting the implementation of clinical pharmacy activities for older inpatients. LeBlanc et al.^[57] distributed a worldwide survey, to which almost 600 European pharmacists responded. Among European pharmacists who were assigned one or several clinical specialties, 7% worked in geriatric units, which was far behind the percentage of pharmacists working in critical care (35% of respondents) or in surgery (20% of respondents). However, the results must be interpreted with caution given the relatively small number of respondents.

At least four controlled trials in Europe have evaluated the impact of clinical pharmacists in the acute care of older people on appropriateness of prescribing and/or related outcome measures.^[21-24] In three of these studies, the intervention provided by pharmacists was very similar. Pharmacists performed medication histories on admission, medication reviews and individualized patient counselling during the hospital stay, and communicated with patients and with practitioners in primary care at discharge.^[21-23]

Spinewine et al.^[21] performed an RCT to evaluate the effect of the pharmaceutical care provided in addition to acute geriatric evaluation and

management care on the appropriateness of prescribing. 203 patients admitted to an acute geriatric unit in Belgium were randomized. When comparing appropriateness of prescribing on admission and at discharge, intervention patients were significantly more likely than control patients to have an improvement in the Medication Appropriateness Index (MAI) and in seven criteria of underprescribing. With regard to clinical outcomes, the authors reported a trend toward decreased rates of mortality and emergency department visits, but the study was not powered to detect significant differences. A related paper described the implementation of the service and the interventions made by the clinical pharmacist, together with factors likely to have contributed to successful implementation.^[58] Overall, 90% of the interventions made by the clinical pharmacist were accepted. Among the interventions that had a clinical impact, 68.3% and 28.6% had moderate and major clinical significance, respectively.

The two other studies were performed in Sweden.^[22,23] The population involved patients admitted on acute internal medicine wards and excluded patients under the care of a geriatrician.

In the study by Gillespie et al.,^[22] 400 patients aged 80 years and older admitted to two acute internal medicine wards in a teaching hospital in Uppsala, Sweden, were randomized to either usual care or direct involvement of a pharmacist at the ward level in addition to usual care. Three pharmacists were involved. They performed medication histories on admission, medication reviews and individualized patient counselling during the hospital stay, and made follow-up telephone calls 2 months after discharge and communicated with practitioners in primary care. Suggested actions relative to medication review were carried out in 75% of the cases. The authors reported significant reductions in all visits to the hospital and in visits to the emergency department 12 months after discharge. Drug-related readmissions were reduced by 80%. Balanced cost savings were \$US230 per patient (2006 year value). No data on appropriateness of prescribing have been published so far.

The second Swedish study evaluated the impact of systematic medication reconciliations on

hospital admission and of a medication review while in hospital on the number of inappropriate medications and unscheduled drug-related hospital revisits.^[23] 210 patients aged 65 or older who were admitted to one of three internal medicine wards at a teaching hospital in Sweden were included. The intervention was provided by a multidisciplinary team that included a clinical pharmacist. The primary outcome measure was the change in the number of drugs with at least one inappropriate score between admission and discharge, using the MAI. Evaluators were blinded. There was a greater decrease in the intervention than in the control group ($p=0.0446$). Surprisingly, no significant differences were found in the patient MAI score or the MAI score per drug. Despite this, the authors reported significantly less drug-related hospital revisits in the intervention group within 3 months of discharge from hospital.

These three studies show that involving a clinical pharmacist in the acute care of older patients can improve appropriateness of prescribing and even improve clinical outcomes.

These results contrast with the findings of a fourth study, performed in Denmark. Lisby et al.^[24] randomized 100 older patients admitted to an acute ward of internal medicine to usual care or systematic medication review and medication counselling by a clinical pharmacist and clinical pharmacologist. There was no difference in in-hospital length of stay, which was the primary outcome measure. No differences were found on readmissions, mortality, contact with primary healthcare and quality of life at the 3-month follow-up. The authors also reported that less than 50% of the recommended medication changes were accepted, which is considerably lower than the proportion reported in other studies. This might have been due to the lack of face-to-face discussions with physicians.

The four studies share common limitations, i.e. they were single-centre studies, with a limited number of pharmacists providing the intervention, therefore limiting generalizability. Contamination bias was also present in all studies (HCPs cared for control as well as intervention patients), which might have diluted the effect of the inter-

vention. Additional data from larger scale studies are therefore necessary to confirm these results, together with additional economic analyses to evaluate the cost effectiveness of such interventions.

6. Role and Impact of the Pharmacist on Continuity of Care

In addition to the above studies, several studies specifically evaluated the impact of interventions provided by pharmacists at the moment of transition across settings of care. Most studies focused on the transition from hospital to the community or the nursing home setting.

Two RCTs were performed in the UK. Nazareth et al.^[25] found no effect with regard to the implementation of a pharmaceutical discharge plan plus home visits after discharge on hospital readmission, medication knowledge and adherence, and patient satisfaction. In contrast, Al Rashed et al.^[26] reported that inpatient pharmaceutical counselling, linked to a medication and information discharge summary and a medicine reminder card, contributed to better drug knowledge and compliance together with reduced unplanned visits to the doctor and readmissions. A pharmaceutical domiciliary visit consolidated the improved healthcare outcomes.

A recent review on the effect of interventions to reduce drug-related problems in older people after discharge concluded that the interventions tested have not yielded conclusive results, but that the most efficient interventions seem to be those that focus on discharge planning, and that their effectiveness improves further when they are combined with home follow-up strategies.^[59]

7. Conclusion

This review has updated previously published reviews by including several recent European studies. From the literature reviewed, it is clear that when pharmacists play a proactive role in performing medication reviews and in the active education of other HCPs, pharmacotherapy for older patients is improved. However, the evidence of the impact of pharmacists' interventions on health outcomes, quality of life or cost effectiveness

of care is mixed. One reason might be that the wrong health outcomes have been used. In fact, mortality, utilization of healthcare services and quality of life are all multifactorial. Further research should rather focus on outcomes that are more responsive to pharmacy interventions, such as ADEs.

It is apparent from the studies reviewed that in order for pharmacists to add significant value to the optimization of older patients' pharmacotherapy, they need to collaborate closely with other HCPs (mainly physicians and nurses). Better outcomes have been demonstrated when the pharmacists have had access to patient records, and have actively spoken with patients and other HCPs as part of a multidisciplinary team. Further in-depth analysis is warranted to identify additional factors that are fundamental to success.

Pharmacists at undergraduate level are uniquely trained in pharmacotherapy and pharmaceutical care planning. Postgraduate clinical training can further increase their clinical skills to provide structured medication reviews, particularly in frail older patients taking multiple medications. Many of the studies seem to have provided the pharmacists with minimal education and training updates, i.e. training was done over one or two sessions; this might be grossly insufficient given the complexity of optimizing pharmacotherapy in older people. Studies also did not seem to standardize for the postgraduate experience of study pharmacists. Similarly to a recent comment by Hanlon,^[60] we believe that it is important to include teaching in pharmaceutical care and geriatric pharmacotherapy at the undergraduate, postgraduate and continuing education levels.

Even though several RCTs have been performed in European countries over the last 10 years (predominantly in the UK and Scandinavian countries; southern and eastern European studies are underrepresented), the majority of studies published to date have been performed outside of Europe (table II). Therefore, opportunities exist for multicentre, European-based, pharmacist-intervention trials in all settings, to determine the effectiveness and economic benefit of pharmacist involvement in the optimization of pharmacotherapy in older persons across Europe. Any such

study in the future also needs to encompass direct patient involvement from the outset, as the studies reviewed for this paper have highlighted the lack of direct participation of older patients in the intervention process.

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