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Review

Economic evaluation of pharmacist-led medication reviews in residential aged care facilities

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Abstract

Introduction: Medication reviews is a widely accepted approach known to have a substantial impact on patients' pharmacotherapy and safety. Numerous options to optimise pharmacotherapy in older people have been reported in literature and they include medication reviews, computerised decision support systems, management teams, and educational approaches. Pharmacist-led medication reviews are increasingly being conducted, aimed at attaining patient safety and medication optimisation. Cost effectiveness is an essential aspect of a medication review evaluation.

Areas covered: A systematic searching of articles that examined the cost-effectiveness of medication reviews conducted in aged care facilities was performed using the relevant databases. Pharmacist-led medication reviews confer many benefits such as attainment of biomarker targets for improved clinical outcomes, and other clinical parameters, as well as depict concrete financial advantages in terms of decrement in total medication costs and associated cost savings.

Expert commentary: The cost-effectiveness of medication reviews are more consequential than ever before. A critical evaluation of pharmacist-led medication reviews in residential aged care facilities from an economical aspect is crucial in determining if the time, effort, and direct and indirect costs involved in the review rationalise the significance of conducting medication reviews for older people in aged care facilities.

Keywords: Pharmacoeconomics , Health Economics , Pharmacist , Pharmacy , Agedcare facilities

1. Introduction

Population aging is a global phenomenon. While population aging should be acknowledged as the outcome of successful healthcare, the aging society on its own represents a reign of challenges in any healthcare model [1]. There has been considerable concern pertaining the increased demand on the healthcare system and related costs [2]. The demand for healthcare services will exceed the population growth rate, given the disproportionate projected growth rate of older people. Consequently, a significant proportion of healthcare funds (30 to 60% of total healthcare costs) will be consumed by the older population [3-5].

The aging phenomenon has also led to an increase in hospital related admissions [6]. Older people residing in nursing homes consume four times more medicines compared to their aged-matched healthy counterparts in the community [7]; the prescribing of multiple medications is often an outcome of guideline-adherent care and this is associated with the addition of more medicines to achieve disease-specific targets [8]. This predisposes older patients to polypharmacy which is commonly defined as taking five or more medications [9]. The mean number of medications prescribed to each resident in the United Kingdom was 4.4 in 1998 [10], 6.9 in 2003 [11], and 8.0 by 2007 [12]. Polypharmacy is also observed in approximately 80.0% of residents in aged care facilities in Australia [13]. In the United States, the Center of Medicare and Medicaid Services enacted a quality indicator measure directed at patients on nine or more medications; the 2004 United States Nursing Home Survey identified 39.7% residents with polypharmacy as defined by this quality indicator measure [14].

Polypharmacy among older people in nursing homes may be a risk factor to the increased healthcare expenditure as the medication cost for older people in developed countries account for a large proportion of the total healthcare expenditure [15]. Approximately 59.0%

of all medications dispensed in England were aimed at older people ≥ 60 years, with an estimated cost of £4.4 billion per annum on pharmaceutical ingredients only [16]. Hence it is pivotal that medication effectiveness (risk-benefit or rationalisation of use) is given precedence during the prescribing process [15]. This concern is amplified by the fact that about 50.0% of long-term medications have been reported to be inappropriate [17]. Evidently, polypharmacy is depicted as a strong predictor of potentially inappropriate medications (PIMs) [18].

Inappropriate medications or potentially inappropriate medications with regards to older people may be defined as “medications or medication classes that should generally be avoided in persons 65 years and older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available” [19]. The use of PIMs may increase the possibility of developing adverse drug reactions (ADRs), which could in turn lead to presentations at emergency departments of hospitals. Interestingly ADRs in at least one quarter of community-dwelling older people were preventable by avoiding PIMs [20]. Hospitalisations due to ADRs increased from approximately 13.0% among those prescribed two medications to 82.0% among those prescribed seven or more medications [21].

The cost of ADRs due to hospitalisations is multifactorial. The main costs of ADR in hospitals are many and they can be categorised as direct and indirect costs. Medications, disposable goods and wages form the foundation of the direct costs [22] whereas missed days from work or morbidity such as anxiety, as a result of ADR episodes, are the indirect costs [23]. The cost for preventable ADRs (e.g. avoiding the use of PIMs) has been estimated to be higher than that of non-preventable ADRs [24]. The cost per ADR in an inpatient setting was

reported as \$US 2262; the inpatient ADR costs vary within different hospital wards, approximately \$US 13,994 in a non-intensive care unit (non-ICU) and \$US 19,685 in the ICU [25]. An extended duration of hospital stay and outpatient care because of ADRs inevitably contribute to healthcare's financial burden [26].

It is evident that medication optimisation in this population is crucial. Various interventions to optimise pharmacotherapy in older people residing in nursing homes have been described and evaluated in practice and reported in literature. They include medication reviews, pharmacist interventions, multidisciplinary team interventions, geriatric evaluation, computerised decision support systems, management teams, and educational approaches. Pharmacists have been in the forefront of many of these approaches [27].

Of the approaches that have proven beneficial in optimising medications, medication reviews offer many benefits [11, 28]. Medication review is defined as “a structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimising the impact of medicines, minimising the number of medication-related problems and reducing waste” [29]. The medication review process has been recognised to promote appropriate polypharmacy, decrease the use of inappropriate medications, aid in identification of possible and true drug-related adverse events; it also offers an opportunity to promote medication adherence [30].

Pharmacist-led medication reviews have formed the foundation of numerous intervention studies in the United Kingdom, the United States, Sweden, Switzerland, Norway, Netherlands, and Australia [31]. They are known as Residential Medication Management Review (RMMR) in Australia, Medication Therapy Management (MTM) in the United States, Medicines Use Review in the United Kingdom and New Zealand, and MedsCheck in Canada

[32-36]. These services are remunerated by the government or healthcare providers for individual items of service; they could also be bulk-funded or associated with capitation models. They are hence termed 'fee-for-service' pharmacist-led medication reviews [37].

Fee-for-service medication reviews led by pharmacists as part of their routine jobs are known to confer many benefits such as attainment of biomarker targets for improved clinical outcomes, reduced hospitalisations, reduced mortality, and improved quality of life [37]. Pharmacist-led medication reviews are aimed at attaining patient safety and are increasingly being conducted [38-40], particularly in aged care facilities, for the reasons discussed above.

Hence a comprehensive summary of the current literature is crucial in determining the cost effectiveness of pharmacist-led medication reviews in nursing homes. This is pivotal in addressing two main issues: the rising healthcare costs on care for older people and the increasing rates of institutionalisation that urges the need for medication optimisation within this population. A critical evaluation of pharmacist-led medication reviews in residential aged care facilities from an economical aspect is crucial in determining if the time, effort, and direct and indirect costs involved in the review rationalise the significance of conducting a medication review for older people in aged care facilities.

2. Cost-effectiveness of pharmacist-led medication reviews

Cost effectiveness is an essential aspect of a medication review evaluation. Basic costs are relatively easy to identify and measure. Then again, the cost of prescribing extends beyond the cost of a medication listed on the prescription; the costs of the prescribing, dispensing and monitoring processes should be taken into consideration. Cost also comes into play when bodily biochemical repercussions occur while reviewing the outcome of starting,

stopping or switching brands of medications that may or may not cause ADRs. Cost also comes into play when a review is performed as an outcome of discontinuation of a medication, just as it would when the original medication is to be restarted for the patient or if switching to a more expensive alternative is deemed appropriate [15].

3. Scope of the Review

We assessed medication review based interventions conducted by pharmacists, aimed at improving medication cost savings in aged care settings. The PubMed (United States National Library of Medicine, Bethesda, MD, USA) and OVIDMEDLINE were searched between January 2000 and December 2015. References cited in the reference list of each identified original research or review article were scanned for any additional articles that would possibly be relevant to this review; these were subsequently also scanned for reviews and studies which may have been relevant and which were subject to the same eligibility evaluation.

Two investigators (SSH and CSK) screened abstracts of articles published in English that evaluated (a) cost-effectiveness of medication review-based interventions in residential aged care facilities, (b) reports of pharmacist-led reviews in aged care facilities, and (c) outcome measures and impact of interventions on cost savings (medications). Studies focusing on clinical and/or educational approaches or interventions, and evaluations of cross-sectional or case series data were excluded, whereas randomised controlled trials, longitudinal studies, and those measuring pre and post medication review interventions were included.

A total of 8 studies were ultimately included in the review, six observational studies and two randomised controlled trials. The researchers carefully assess the studies against a quality

checklist to estimate a quality of studies in terms of deficiencies. The 11-item checklist was consisted of questions related to design specific protection against bias (prospective vs retrospective), protection against selection bias (e.g. refusals, attrition), protection against information bias (adequate follow-up, accuracy of measurements of diabetes and depression) and adequate consideration of confounders.

The eight studies evaluated the cost-effectiveness of medication review interventions in aged care facilities. Both RCTs were conducted in the United Kingdom. The observational studies (n = 6) used the following study designs: two prospective and four pre and post intervention studies. Of the six studies, three were conducted in the United States, and 1 each in Switzerland, Singapore, and the United Kingdom. Medication reviews performed by pharmacists alone or in collaboration with other health care professionals result in significant drug cost savings. The studies evaluating cost-effectiveness of pharmacist-led medication reviews are summarised in **Table 1**.

4. Cost-effectiveness of pharmacist-led medication review

An eight-month prospective randomised controlled trial (four months of observation followed by four months of intervention) evaluated medication reviews by a pharmacist for older residents of fourteen nursing or residential homes (Furniss *et al*, 2000) [10]. One home in each pair was allocated using computer-generated pseudo-random numbers to receive either a regular medication review by a pharmacist (intervention group) or no medication review (control group). In the intervention group, the pharmacist suggested medication changes for each resident after collecting details of current medications from the medication chart, a brief medical history and current problems identified by the home staff. The homes were revisited three weeks after the medication review to ascertain if the

suggested changes had been implemented. The overall associated costs of all contacts with primary and secondary care resources were calculated for each home and divided by the number of residents in the study period to generate average costs per resident. At the end of the intervention phase, the average total costs per resident in the intervention arm was 314.89 sterling pounds compared to 492.98 sterling pounds in the control group, a difference of 178.09 sterling pounds. This difference was mostly due to lower average costs for in-patient days per resident in the intervention arm (55.67 sterling pounds) compared to the control group (256.54 sterling pounds). Nevertheless, the authors could not perform a statistical comparison of these average costs because only fourteen homes in total could be included in this study.

In 2004, Christensen *et al.* [28] determined the impact of a drug therapy management intervention program on nursing home drug costs. This program was designed by AccessCare Inc., a component organization of the Community Care of North Carolina (CCNC) program. The program involved a systematic drug regimen review by pharmacists during regular scheduled nursing home visits, and subsequent communication of recommendations to prescribing physicians and, to obtain results. To ensure consistency of the interventions, each pharmacist was provided with printed drug profiles of screened patients and a proprietary Toolkit which contained instructions for documenting consultations and explanations of the screening criteria which assisted the involved pharmacists in reviewing specific drug(s) or drug classes that possessed the potential to save costs. The first screening criterion was the Beers drug list, a list of drugs generally considered to be inappropriate for use in the elderly. The second screening criterion was the CCNC Prescription Advantage List (PAL) which prompts substitution of less expensive drugs within a therapeutic class. The list was further divided into drugs that offered no clear cost advantage (PAL-2) and would incur

significant costs (PAL-3). The third screening criterion was receipt of a drug on a list of clinical initiatives.

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Table 1: Cost-effectiveness studies of medication reviews in the nursing homes

Study (year)	Study details	Duration (months)	Location	Medication review type	Cost-effectiveness
Chia et al (2015)	Design: pre-post review No of residents: 480 No of homes: 3	6	Singapore	Clinical medication review by pharmacist	Total cost savings Pre: SGD 388.30 Post: SGD 876.69
Baqir et al (2014)	Design: pre-post review No. of residents: 422 No of homes: 50	12	UK	Clinical review by multidisciplinary team with pharmacist	Net annualised savings: £184 per person reviewed
Brulhart et al (2011)	Design: prospective (2007-2009) No. of residents: 329 No of homes: 10	36	Switzerland	Prescription review by pharmacist	Intervention: annual decrement of drug costs: 14.6% Control: 0.1% decrement
Trygstad et al (2009)	Design: prospective records-based No. of residents: 8087 No of homes: 253	3	USA	Prescription review by pharmacist	Drug-cost savings: USD21.63 per member per month
Zermansky et al (2006)	Design: RCT No. of residents: 661 No of homes: 65	1	UK	Clinical medication review by pharmacist	Cost of drugs per patient per 28 days: Intervention: £42.24 Control: £42.94
Trygstad et al (2005)	Design: pre-post review No. of residents: 6344 No of homes: 253	6	USA	Prescription review by pharmacist	Median drug costs per resident: Intervention: decrement of USD 12.14 Comparison: increment of USD 44.98
Christensen et al (2004)	Design: pre-post review No. of residents: 9208 No of homes: 253	3	USA	Prescription review by pharmacist	Mean drug regimen cost per patient per month: Post Intervention: USD 472.63 Pre-intervention: USD 502.96 Mean drug cost savings: \$30.33 per patient per month
Furniss et al (2000)	Design: RCT No. of residents: 330 No of homes: 14	8	UK	Clinical medication review	Avg total costs per resident: Intervention: £314.89 Control: £492.98

Note: 1 USD = 0.76 sterling pounds; 1 USD = 1.36 SGD

Screening regimens with the Beers drug list resulted in significant mean drug cost savings of US dollar (USD) 2.49 per patient ($p < 0.001$). Screening with PAL-2 and PAL-3 lists resulted in a significant mean savings of USD 18.04 per patient and USD 18.94 per patient, respectively ($p < 0.001$). Screening with a clinical initiative list produced a significant mean saving of USD 65.04 per patient. After taking all patients and all prescriptions into consideration, the mean drug regimen cost of each patient per month after intervention (USD 502.96) was significantly lower than before the intervention (USD 472.63), a mean reduction of USD 30.33/patient per month ($p < 0.001$).

In 2005, Trygstad *et al.* [38] assessed the impact of a focused drug therapy management intervention on drug costs from a payer perspective among nursing home residents with more than 18 prescription fills in 90 days. The intervention involved a drug utilisation review by consultant pharmacists who were provided with drug profiles of participating residents that displayed flags and suggestions for modifications of drugs and drug classes. These consultant pharmacists were required to conduct drug utilisation reviews during their regularly scheduled visits to each home, to communicate recommendations to prescribing physicians, and to follow through on outcomes of recommendations. The study utilised a before-after, study-comparison group design in which drug costs during the 3 months before and after the intervention were compared between study-group residents and comparison group residents. Study-group residents received a completed profile review by consultant pharmacists while the comparison group comprised of residents residing in nursing homes who were not included for the intervention.

After the 3-month follow-up period, median drug costs per resident in the intervention group decreased from USD 1,329.46 to USD 1,317.32, with the amount of savings per

resident per month of USD 12.14 ($p = 0.06$). On the other hand, median drug costs per resident in the comparison group increased from USD 1,341.25 to USD 1,386.23, an increment of USD 44.98. This created a relative cost savings per resident of USD 57.12 or USD 19.04 per resident per month. When a subgroup of residents having documented profile reviews and recommendations resulting from the pharmacists' consultation was analysed, a larger amount of savings per resident was observed with a median cost savings of USD 25.83 ($p < 0.01$). An even larger amount of savings per resident was observed in a subgroup of residents having a change in therapy as a result of a recommendation provided by consultant pharmacists with a median cost savings of USD 61.68 per resident ($p < 0.01$).

In 2006, Zermansky *et al.* [11] reported an open randomised controlled trial of clinical medication review by a pharmacist of elderly care home (nursing, residential and mixed) residents taking at least one repeat medication against usual care to determine the cost of 28 days of repeat medicines per participant as one of the secondary outcomes. Residents were randomised to receive either a clinical medication review by a pharmacist or usual care in randomly sized blocks of two to eight residents using a pre-determined algorithm. In the intervention arm, the study pharmacist performed a clinical medication review within 28 days of randomisation which comprised a review of the general practitioner clinical records and a consultation with the resident and carer. The pharmacist-formulated recommendations were written on a proforma which was subsequently delivered to the treating general practitioner for acceptance and implementation. Residents in the control arm received usual medication reviews by a general practitioner.

This study reported no significant difference ($p > 0.05$) in the cost of 28 days of repeat medicines per participant between intervention (42.24 sterling pounds) and control groups

(42.95 sterling pounds). Nevertheless, as indicated by the authors, the results did not suggest that clinical medication reviews by the pharmacist achieved no cost savings. More medications were discontinued in the intervention group, but such savings from drug discontinuation were offset by the additional costs incurred to address new therapeutic issues, turning cost-benefit into opportunity-benefit with no increase in overall medication cost.

In 2009, Trygstad *et al.* [39] reported a prospective records-based study of the impact of large-scale medication therapy management in long-term care homes on drug costs. In the program, consultant pharmacists performed monthly retrospective drug regimen reviews for long-term residents. The program also had a prospective component in which consultant pharmacists could intervene and request for drug change as new medication orders came into the dispensing facility. To ensure equivalence among subjects, propensity scoring was used to match study subjects from participating long-term care homes with comparison counterparts from non-participating long-term care homes. While some residents received only retrospective reviews and interventions, some received only prospective interventions, and some received both types; residents with interventions were grouped for analysis by intervention type - retrospective only, prospective only, or dual type. Residents were further categorised by intervention stage - review, recommendation and drug change, which produced a total of 10 cohorts, including an all-inclusive grouping that aggregated groups by intervention type. Results are based on intention-to-treat analyses for all the cohorts.

Overall, a significant drug-cost saving of USD 21.63 per member per month was observed ($p < 0.05$). These savings were observed at both the recommendation and drug-change levels, with USD 30.64 ($p < 0.001$) and USD 38.05 ($p < 0.001$) per member per month, respectively.

The drug-cost savings increased at intervention stages (retrospective only, prospective only, or dual type), closer to the drug-change stage (i.e. moving from [review] to [review and recommendation] to [review, recommendation, and drug change]). All 10 cohorts had statistically significant drug-cost savings (per member per month); residents with retrospective-only interventions at the drug-change level achieved the largest savings, i.e. USD 41.96 per member per month ($p < 0.05$).

In 2011, Brulhart *et al.* [40] evaluated the economic impact of a pharmaceutical care intervention model for residents of nursing homes in a prospective study. The intervention model involved collection of medication use data and subsequent reviews by a pharmacist, focusing on drug indications, risk of medication errors, dosing, side effects, renal/hepatic elimination and drug-drug interactions. Identified drug-related problems and their proposed actions were then discussed with the physician and a nurse providing care. All residents in the participating nursing homes were randomly selected for inclusion in the study. The economic impact of the intervention was estimated via a retrospective evaluation of annual drug costs in participating nursing homes, three years pre and post intervention. The residents of the nursing homes in which medication reviews were not implemented during the study period, served as a control group for the economic evaluation.

Over one thousand drug related problems were detected and discussed with the physician and the nurse during the study period. Medication review led to 343 medical evaluations secondary to drug-drug interactions and 803 treatment adaptations. This results in a definite decrement of annual drug costs of 14.6% in nursing homes with pharmacist-led medication reviews three years after implementation of the pharmaceutical care

interventions. The decrement was insignificant in the nursing homes with no medication review interventions, where only a 0.1% decrement in the annual drug costs was registered. In 2014, Baqir *et al.* [41] performed basic health economic evaluation of multidisciplinary medication reviews among residents of nursing homes involving pharmacists. The pharmacists first undertook a detailed medication review using primary care records, taking into account the indication, appropriateness, co-morbidities, residents (or carers') views, and drug omission. Since the residents were under the care of different general practices, four subsequent working models with general practitioners were developed. In the first model, the general practitioners attended the multidisciplinary team meeting involving the care home nurses and decisions were jointly made with the care home nurses and pharmacists. In the second model, all interventions were discussed with the general practitioners following the medication reviews prior to the multidisciplinary team meeting. In the third model, all interventions were discussed with the general practitioners after the multidisciplinary team meeting prior to resident involvement. In the fourth model, the prescribing pharmacists led the intervention with no involvement of the general practitioners although general practitioners were allowed to challenge the interventions. Suggested interventions were then discussed with the residents and/or their family with the final decisions made jointly with the residents (or their family) where this was possible. Overall, costs paid for changing and starting medicines were 4,138 sterling pounds per annum while costs (~ 1 USD = 0.76 sterling pound) saved for changing or stopping medicines were 81,989 sterling pounds per annum. The net annualised saving was 77,702 sterling pounds or 184 sterling pounds per resident from the medicines budget. After considering the total cost of delivering the intervention (32,670 sterling pounds or 77.42 sterling pounds per resident), it was concluded that for every 1 sterling pound invested, 2.38 sterling pounds

could be saved. The savings against the medicines budget with the first model was £234 per resident per annum while cheapest service delivery was achieved with the fourth model without a general practitioner's involvement (£58 per resident). For every 1 sterling pound invested, the greatest savings was achieved using the fourth model (£3.53 per resident) while the third model achieved the least savings (£1.30 per resident). The results of economic analysis revealed that the fourth model was more cost effective (i.e. more interventions and medicines stopped with less delivery cost) than the second and third models but less efficient than the first model (i.e. fewer interventions and medicines stopped with less delivery cost).

In 2015, Chia *et al.* [42] reported a retrospective study to determine potential cost savings gained from pharmacist-led medication reviews in nursing homes. Data was collected during a one-month pre-setup period where the pharmacists performed medication reviews on all the enrolled residents and during a six-month post-setup period where the pharmacists performed weekly medication reviews on all the enrolled residents again. During the reviews, the pharmacists examined the medication records, case notes and medical charts as well as observed and interviewed the residents or nurses to better understand the residents' conditions. In the pre-setup period, a written summary of pharmacotherapy problems identified during the medication reviews were handed to the general practitioners for their perusal. In the post-setup period, the pharmacists approached the general practitioners in their preferred ways to gain approval for their recommendations. Monthly cost savings as a result of drug discontinuations or substitutions following the medication reviews were calculated and compared with the monthly costs of pharmacist reviews to compute the net savings.

The average monthly costs of pharmacist reviews during the pre-setup period and post-setup period were SGD 4,800 and SGD 800, respectively ($\sim 1 \text{ USD} = 1.36 \text{ SGD}$). The monthly direct cost savings during the pre-setup period and post-setup period were SGD 388.30 and SGD 876.69, respectively. The mean cost savings per recommendation was SGD 12.94 during the pre-setup period and SGD 19.06 during the post-setup period. When the costs of pharmacist reviews were factored in, the monthly direct cost savings during the pre-setup period were not enough to cover the cost of pharmacist reviews (SGD 4,800), with a negative net saving of $-\text{SGD } 4,411.70$. However, a positive net saving of SGD 76.69 per month was recorded during the post-setup period.

5. Expert commentary

The cost-effectiveness of medication reviews are more consequential than ever before. Despite the abundance in medical literature studies evaluating medication review services, only a handful discuss cost-effectiveness issues. Most of the published cost-effectiveness evaluations of medication review services involve medication reviews by pharmacists. The pharmacist-led medication reviews discussed above depict concrete financial advantages in terms of decrement in total medication costs and associated cost savings. For example, all three publications from the 2000 to 2014 period in the UK (included two RCTs) have depicted that medication reviews provided by the pharmacist are a superior service as opposed to no service or usual service in terms of drug cost savings. The cost savings in some studies were more apparent in the intervention group as opposed to the control group whereas in other studies the net savings did not vary much between both groups. However it must be acknowledged that drug cost savings do not automatically translate to reduction in healthcare costs (as it does not cover future hospitalisations, investigations, follow-ups etc.) and/ or improved patient outcomes. This thought-provoking phenomenon

can be comprehended in many ways, but we suggest exploring this occurrence in a *domino theory*-like approach, that will be discussed below.

Firstly, it would be worthwhile to consider cost savings from the perspective of a patient, as older people are increasingly assuming the responsibility over their own healthcare. The value of their healthcare expense is perceived as a cost relationship between their out-of-pocket expense and quality, which is largely equated with service [46]. This provides insight on the perception of patients that should be valued as it indirectly provides a potential solution in cost minimisation for healthcare. From the viewpoint of a nursing home setting, it is pertinent that older people are given the opportunity to empower their own health as many of them often portray diminished autonomy. It is best to seek practical solutions to improve the healthcare system such that it will provide older people with added healthcare value whilst minimising on cost.

A defining tenet in the optimisation of pharmacotherapy for the older population is by adopting a patient-centred approach; this approach to healthcare could be perceived as a strong contender in the pursuit of cost-minimisation. Patient-centred care is defined as an approach to health care that is responsive to, and respectful of, the preferences and values of the patients [47]. Healthcare practice that involves patient activation is related with significantly lower primary care charges, and there has been increasing evidence for a relationship between patient-centred care and utilisation of medical supplies [48-49]. Patient-centred care may promote trust between the physician and a patient, and enhance patient knowledge, thereby eliminating the necessity for hospital care use, specialty referrals and diagnostic testing, which can negate unnecessary healthcare expenditure [49].

The various elements that encompass a patient-centred approach are information and communication, care coordination, continuity and transition, access to care, involvement of the family and carers, respect, emotional support and physical support [47]. Subsequently medication review can be regarded as an essential component of patient-centred care, and it has also been widely described [47, 49-51]. Although there are many definitions pertaining activities of a medication review, none of them are able to include all activities but one commonality that exists between all definitions is that the highest level necessitates patient involvement [50].

Various classifications of medication review have been derived to cater for the needs of patients for particular purposes. Clinical medication review addresses issues pertaining the patient's medication use with regards to their clinical condition whereas prescription review tackles technical issues pertaining the prescription, such as anomalies or medication changes. Concordance and compliance review addresses issues pertaining the patient's medicine-taking behaviour. It is imperative to note that the clinical medication review and compliance and concordance review typically require the presence of the patient, although all review outcomes ultimately require consent from the patient and their caregivers [51].

It is commendable that the pharmacist-led medication reviews that have been critically reviewed in this paper involve either a clinical medication review or a prescription review, indicating that patients were aware of their medication changes. As mentioned earlier, the cost savings that resulted from the pharmacist-led reviews are apparent although in view of enhancing the value of the service whilst saving on cost, it is worth exploring other opportunities to improve the clinical knowledge of pharmacists in providing effective medication reviews. Similar in view to comments by Spinewine et al. [31], we believe that it

is essential for pharmacists to undergo a systematic training structure in reviewing medications of older people, for instance postgraduate clinical training that is focused on medication optimisation in geriatrics and gerontology. This idea is strengthened based on a comment by Hanlon [52], who emphasised the importance of incorporating geriatric pharmacotherapy and pharmaceutical care at the undergraduate, postgraduate and continuing educational programme levels. Pharmacists training at the undergraduate level may not necessarily suffice, and many of the studies discussed in this paper did not include proper training programmes prior to the pharmacists' reviews. Appropriate training in reviewing medications will add value to, and further increase the healthcare quality that may negate the need for additional consultations that are known to be associated with increased costs.

Notwithstanding the benefits of a pharmacist's expertise in a patient-centred approach while reviewing medications, the most essential outcome of patient-centredness is undeniably patient safety and quality care. The nascent discipline of patient safety has not been comprehensively defined up to date, mainly because a very fine line distinguishes *safety* and *quality*. While this definition may remain an exercise of semantics to some, the Agency of Healthcare Research and Quality has defined patient safety as "a discipline in the health care sector that applies safety science methods toward the goal of achieving a trustworthy system of health care delivery. Patient safety is also an attribute of health care systems; it minimises the incidence and impact of, and maximises recovery from, adverse events" [53]. On the other hand, the Institute of Medicine defined the quality of health care; "quality of care is the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" [54]. Health care quality issues were further categorised into three

groups, i.e. underuse, overuse and misuse, all of which can be curbed by conducting a medication review exercise.

Patient safety and high quality of care are crucial aspects of the cost-minimisation strategy. High quality care promotes patient safety, thereby eliminating risks of healthcare-related errors and adverse effects. Patients themselves have indicated preventable harm in health care and the impact it has inflicted upon them. The elderly are predominantly vulnerable and are disproportionately affected in terms of patient safety incidents and this may cause adverse events, which could ultimately result in trauma or even death [47, 55]; this will undoubtedly contribute to the increasing healthcare costs associated with this population. Review of the current health care system should be done in tandem to possible development and implementation of various programmes and interventions that have been described in the World Health Organization Patient Safety Tool Kit [56].

For the reasons discussed above, government health policies should aim at investing in medication optimisation strategies for the older population. The strategies should leverage on the expertise of pharmacists at optimising medications for older people in nursing homes, a population that suffers from the conundrum of polypharmacy and inappropriate medications which have led to increased hospitalisations and healthcare expenditure. Pharmacists should be provided with an appropriate platform to undergo appropriate postgraduate clinical training to sharpen their skills. The outcomes should be measured in robust manners, by the conduct of proper randomised controlled trials with long study intervals. Assessment of relevant health quality indicators such as frailty, quality of life, medication burden, and cost-effectiveness of the pharmacist-led reviews in these trials will further support the positive impact of such interventions.

6. Five-year view

The increasing evidence on cost effectiveness of medication reviews in aged care facilities will guide the relevant authorities to plan cost minimisation and reimbursement strategies for improved medication use based on economic evaluations of existing medication reviews. Given the concrete financial advantages in terms of decrement in total medication costs and associated cost savings, it is likely that the future economic evaluations will examine the practicality of working pharmacists and healthcare professionals to allocate time and effort to perform the periodic review processes in the aged care facilities and assess the possibility of financial reimbursement to pharmacists for the additional time spent on performing the review process. To initiate this process, the incorporation of this service into a pharmacist's core job in hospitals or community pharmacies should be explored.

The future economic evaluations should aim at investing in medication optimisation strategies for the older population in nursing homes, a population that suffers from the issues related to polypharmacy and inappropriate medications which have led to increased hospitalisations and healthcare expenditure. A randomised controlled trial with appropriate study intervals offers the possibility of assessing robust cost effectiveness or cost minimisation measures and strategies. Another area of interest in the next few years would be the personalised medication management as it reduces the necessity for hospital care use, speciality referrals and diagnostic testing, negating unnecessary healthcare expenditure.

7. Key issues

- Population aging is a global phenomenon and the demand for healthcare services will exceed the population growth rate, given the disproportionate projected growth rate of older people
- Older people residing in nursing homes are prone to polypharmacy and this may be a risk factor to increased healthcare expenditure as the medication cost for older people in developed countries account for a large proportion of the total healthcare expenditure
- Polypharmacy is depicted as a strong predictor of potentially inappropriate medications that may increase the possibility of developing adverse drug reactions which could lead to presentations at emergency departments of hospitals that contribute to further increase in healthcare expenditures
- Pharmacist-led medication reviews promote appropriate polypharmacy, decrease the use of inappropriate medications, reduce hospitalisations and improve clinical outcomes
- Cost effectiveness is an essential aspect of a medication review evaluation and the cost of prescribing extends beyond the cost of a medication listed on the prescription. The costs of prescribing, dispensing and monitoring processes should also be taken into consideration
- This study aimed at assessing medication review based interventions conducted by pharmacists and this is aimed at improving medication cost savings in aged care settings
- Most studies from the US, UK and Switzerland depicted significant ($p < 0.05$) cost savings when pharmacist-led medication reviews were performed for older people residing in aged care facilities. However two studies from the UK and Singapore reported no significant

differences in cost savings when a pharmacist-led medication review was performed, possibly because savings from drug discontinuation were offset by the additional costs incurred to address new therapeutic issues

- Clinical medication reviews, prescription reviews and concordance and compliance reviews require consent from the patients and caregivers, adopting a patient-centred approach.
- The essential outcome of a patient centred-approach is patient safety and quality care, which are crucial in cost-minimisation; high quality care promotes patient safety, thereby eliminating risks of healthcare-related errors and adverse effects
- Government health policies should aim at investing in medication optimisation strategies for older people

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Declaration of Interest

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