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SYSTEMATIC REVIEW OF PHARMACIST-LED HOME MEDICATION REVIEWS TO IMPROVE ADHERENCE TO ANTIDIABETIC MEDICATIONS AMONG ADULT TYPE 2 DIABETES PATIENTS

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ABSTRACT

Pharmacists can contribute to the improvement in diabetes management and help patients recognise and manage barriers to optimal medication adherence. Home medication review (HMR) services provided by pharmacists could also assist patients in minimising drug-related problems. This systematic review aimed to evaluate and summarise evidence from recent literature on the effectiveness of pharmacist-led home medication review interventions to improve medication adherence in adult type-2 diabetes mellitus (T2DM) patients. Primary research articles published in English from 1st January 2012 to 31st May 2022, were retrieved from five online electronic databases (MEDLINE, Embase, Scopus, Cochrane Reviews and the Web of Science). The methodological quality of all included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklists. The literature search identified 2,178 publications; only four were included in this review. All four studies found that pharmacist-led HMR was associated with significant positive changes in the patient's medication adherence. Significant improvements were demonstrated either through self-reported medication adherence assessment questionnaires or the pill counting adherence ratio before and after HMR visits. There was evidence of statistically significant effectiveness of pharmacist-led HMR initiatives to improve patient adherence to medication among adult T2DM patients.

***Keywords*:** Home medication review, Pharmacist, Medication adherence, Adult type 2 diabetes, Diabetes mellitus

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INTRODUCTION

Due to the considerable morbidity and death that the disease is linked to, diabetes continues to rank among the world's most serious epidemics. The frequency of chronic, non-communicable diseases has been rising alarmingly in recent years around the globe. In 2021, there were 529 million people living with diabetes worldwide and the global age-standardised total diabetes prevalence was at 6.1% in which type 2 diabetes mellitus (T2DM) accounted for 96% of the overall diabetes cases (Ong *et al*. 2023). It had been estimated that 18 million individuals every year died from cardiovascular disease, which has diabetes and hypertension as two of its key risk factors (Tabish 2007). If the increasing trend continues, the number of patients with diabetes is expected to reach 629 million globally in year 2045 (Presley, Groot and Pavlova 2019). The most critical aspect of the optimal management of patients suffering from T2DM is preventing the harmful effects of hyperglycaemia. HbA1c, the percentage of glycated adult haemoglobin, is the most widely used measure of chronic glycaemia (Nathan, Turgeon and Regan 2007). T2DM treatment aims to achieve reasonable glycaemic control. This process encompasses maintaining patients' optimal HbA1c concentrations, reducing postprandial hyperglycaemia and glycaemic variability, and extending the time range in near-normoglycaemia (Ceriello *et al*. 2022). Evidence showed that HbA1c levels below 6.5% for the first year following diagnosis were linked to worse outcomes among patients with newly diagnosed diabetes and 10 years of survival (Laiteerapong *et al.* 2019). Lower HbA1c levels were also associated with lower risks of macrovascular events and death (Zoungas *et al*. 2012). Macrovascular complications could include peripheral vascular disease, heart disease and stroke, which have shown to have a high prevalence among older adults with diabetes. Hence, current treatment standards for diabetes recommend that glycaemic control as a strong predictor for diabetes complications (ElSayed *et al*. 2023).

Proper management of diabetes could also prevent or delay microvascular complications such as retinopathy, nephropathy and neuropathy (Corriere, Rooparinesingh and Kalyani 2013). Since the primary goals of pharmacotherapy for T2DM involve controlling blood glucose and reducing the risk of diabetes complications, medication adherence is crucial for optimal management of diabetes.

Previous studies have shown that medication non-adherence is prevalent among T2DM patients and is associated with adverse clinical outcomes. A systematic review reported that the prevalence of adherence ranged from 38.5% to 93.1% among patients taking T2DM medication (Krass, Schieback and Dhippayom 2015). In a study in the US, 21.3% of T2DM patients were found to be nonadherent (Ho *et al*. 2006), while another study reported a higher prevalence (54.4%) in another country in Africa (Aminde *et al*. 2019). Both studies demonstrated that non-adherence to antidiabetic medications had been significantly associated with higher HbA1c and blood pressure levels. Studies have also shown that higher adherence was associated with improved glycaemic control, fewer emergency department visits, decreased hospitalisations and lower medical costs (Capoccia, Odegard and Letassy 2016). Given the worsening COVID-19 pandemic in the last few years, healthcare policymakers, including health ministries, have undertaken various preventive and awareness programmes such as health campaigns, home medication reviews by pharmacists and patient education sessions for diabetes patients. Patient education programmes are a significant component of treatment for T2DM. This component can help prevent complications, reduce associated treatment costs and provide an effective strategy for supporting patients to adhere to their treatments (Kumah *et al.* 2018).

It is well recognised that enhancing medication adherence among diabetic patients requires the involvement of healthcare providers. Particularly, pharmacists can assist patients in learning about diabetes and discussing the benefits and disadvantages of various treatment options. They are among the community's most approachable healthcare providers. By organising complex treatment regimens, conducting routine medication reviews, and assisting patients in identifying and resolving barriers to good adherence, pharmacists can also help patients better manage their diabetes (Omran, Guirguis and Simpson 2012). Literature has also shown that pharmacist-led interventions could allow patients to achieve their glycaemic goals and improve medication adherence (Presley, Groot and Pavlova 2019).

A pharmacist-led medication review is a service in which a pharmacist assesses a patient's medication regimen to identify and suggest strategies for resolving medication-related issues. Home medication review (HMR) comprises a systematic assessment of patients' medicines and management of those medications to optimise health outcomes (Rosli *et al*. 2021). Globally, pharmacists are reimbursed for conducting medication reviews in Australia, New Zealand, the United Kingdom and the US. Various forms of pharmacist-led medication review in the community or residential aged care settings have also been developed or are under development in several European countries (Presley, Groot and Pavlova 2019). The Australian government initiated the first HMR programme in 2001. The programme was defined as a consumer-focused, structured and collaborative health care service in the community setting to promote better medication adherence (Gudi *et al*. 2019). In Malaysia, the Pharmaceutical Services Division, under the Ministry of Health (MOH) Malaysia, initiated the Home Care Pharmacy Services (HCPS) in 2011. The MOH Malaysia's pharmacists provide the service involving drug reconciliation and medication analysis for prescription and non-prescription drugs (Mohamad, Haron and Amri 2019).

However, very few studies focused on evaluating the impact of pharmacist-led HMR services. A study in Canada reported that pharmacist-directed home medication reviews had proven to offer an effective mechanism to address the pharmacotherapy issues of community members (Papastergiou *et al*. 2013). Two other studies revealed that HMR had significantly improved glycaemic control, patients' knowledge about the disease, and quality of life (Rosli *et al*. 2021; Chow *et al.* 2016). HMR services provided by pharmacists could assist patients in minimising drug-related problems. Implementing such a service will also prevent medication errors and likely improve medication adherence. However, published evidence on the effects of pharmacist-led HMR programmes and medication adherence is still scarce and systematic reviews measuring the impact of such interventions are almost non-existent.

This systematic review aimed to evaluate and summarise evidence from the literature on the effectiveness of pharmacist-led HMR interventions to improve medication adherence in adult T2DM patients. The systematic review question was outlined in a population, intervention comparison and outcome (PICO) format in Table 1.

Table 1: Review question using the PICO format.

Criteria	Description
P: Population	Adult type 2 diabetes mellitus patients (T2DM)
I: Intervention	Pharmacist-led home medication review
C: Comparator	No intervention or usual care
O: Outcome	Medication adherence

METHODS

The review was conducted and reported following the Preferred Reporting Items for Systematic Review (PRISMA) guidelines (Moher *et al*. 2015). Due to our interest in most current publications as well as to retain manageable search results, a 10-year period of the literature search was chosen. Therefore, only primary research articles published in English, from 1st January 2012 to 31st May 2022, which explored the effectiveness of pharmacist-led HMR to increase pharmacotherapy adherence in adult T2DM patients, were included in this review. Those could be either randomised control trials (RCTs), cross-sectional, case-control, cohort or other types of interventional studies. Studies involving a wider range of age groups with no subgroup analysis for the target adult population were excluded. Similarly, studies investigating HMR without medication adherence evaluation as an outcome were also disregarded. In this review, pharmacist-led home medication review included all interventions led by pharmacists while visiting the patients' homes and reviewing their medications from various points of view, including drugs, disease, and lifestyle. The summary of study inclusion and exclusion criteria is tabulated in Table 2.

Table 2: Study inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Quantitative studies, either being: • randomised control trials (RCTs) • cross-sectional • case-control • cohort or • other types of intervention studies	• Studies involving a wider range of age groups with no subgroup analysis for the target adult population 18 years old and above • Studies without medication adherence as the outcome

Search Strategy

The literature search was conducted on 1st July 2022, using five online electronic databases, including MEDLINE, Embase, Scopus, Cochrane Reviews and Web of Science. In addition, unpublished literature from Google Scholar was also searched, including programme reports, newsletters, conference proceedings, technical reports and related abstracts. The terms used to explore each of the databases were a combination of keywords, including 'home medication review,' 'domiciliary medication review,' 'drug therapy review,' 'pharmacist,' 'diabetes mellitus,' 'adherence' and 'compliance.' Boolean operators were also used to combine appropriate medical subject headings (MeSH) terms to identify all relevant studies. The outline of a search strategy used in one of the databases is shown in Table 3.

Table 3: Embase search strategy.

Keywords	Relevant terms
1. Diabetes Mellitus/ 2. Diabetes Mellitus, Type 2/ 3. 1 or 2	Type 2 diabetes mellitus AND

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Table 3: (*continued*)

Keywords	Relevant terms
4. home.mp	Pharmacist-led home medication review
5. domiciliary.mp	
6. "Review"/	
7. medic$ review.mp	
8. "Medication Review"/	
9. Drug Therapy/	
10. Medication Therapy Management/	
11. Medication Reconciliation/	
12. Community Pharmacy Services/	
13. Home Care Services/	
14. Pharmacists/	
15. Or 4-14	
	AND
16. Patient Compliance/	Medication adherence
17. Medication Adherence/	
18. 16 or 17	

Article Selection

All search results were exported into the Zotero reference manager software. Any duplicated publications were removed. The eligibility of potential studies was checked against the specified study inclusion and exclusion criteria. The final list of included studies was prepared and discussed between two independent reviewers (MSAK and SPP). Any disagreements were resolved through proper discussion. The number of studies identified and the reasons for exclusion were then summarised in the PRISMA diagram (Figure 1).

Data Extraction

Data from the final list of articles included in this review was then abstracted using a piloted Microsoft Excel data collection form. The form consisted of the authors' name, country of origin, publication year, study design, study period, sample population, HMR description, medication adherence outcome, measurement tools and main findings. It was also reviewed in consensus among the two independent reviewers.

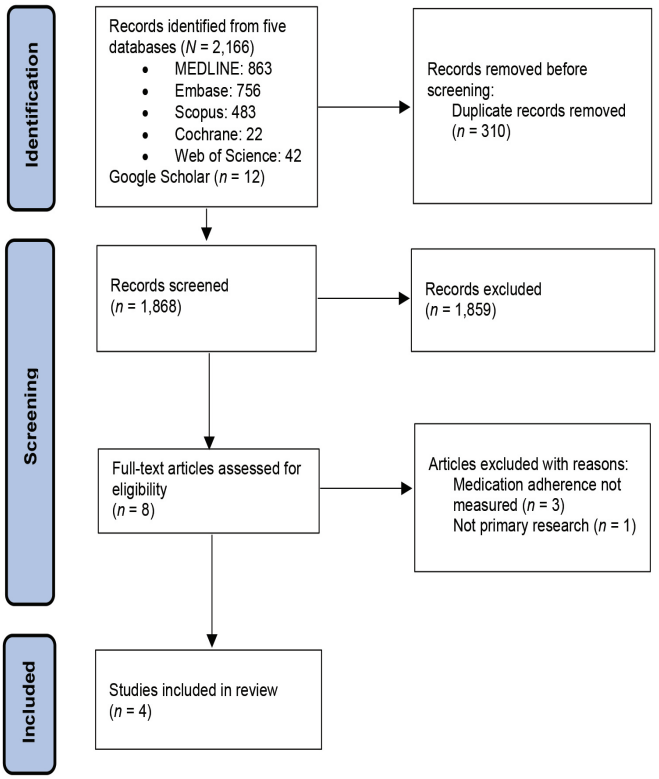

Figure 1: PRISMA diagram.

Quality Appraisal and Data Analysis

In the next step, the two reviewers also assessed the risk of bias and methodological quality of all included studies using the appropriate Critical Appraisal Skills Programme (CASP) (2021) checklists according to each study design. Each question was recorded as either 'yes', 'no' or 'cannot tell', along with detailed reasons for most of the answers. A summary of the appraisal with a conclusion of the overall assessment was done for each study. The process was also done by consensus among the two reviewers.

The outcome of interest in this review was medication adherence, often reported using validated adherence assessment tools, including subjective and objective medication adherence measures. Such measurements could include electronic medication packaging (EMP) devices, medication possession ratio (MPR), pill count, clinician assessments and self-reports (Lam and Fresco 2015). The results were analysed using a narrative synthesis approach (Centre for Reviews and Dissemination 2009).

RESULTS

A total of 2,178 publications were identified from the electronic databases. A total of 310 duplicates were removed, leaving 1,868 articles for further screening. In the next step, the titles and abstracts of each study were read through and only relevant studies of value were included for further analysis. A total of 1,859 studies were excluded based on the inclusion and exclusion criteria. Of the remaining studies, only eight were available for full-text screening. Four studies were eventually excluded as three did not report adherence rates and there was one study that was not primary research. A final total of only four studies were included in this systematic review. The selection process and the number of articles excluded at each stage were shown in the PRISMA diagram (Figure 1).

All four articles involved adult diabetic patients. However, two studies (Zhang *et al*. 2022; Al-Qudah *et al.* 2018) specifically mentioned the inclusion of patients with other comorbidities. Those could include other cardiovascular diseases such as hypertension, dyslipidemia, coronary diseases and stroke. All studies included patients taking at least three different types of medications. Three studies were conducted among patients receiving treatments from the local primary healthcare facilities. In contrast, one involved the outpatients of a teaching hospital.

General Characteristics of the Included Study

Overall, this systematic review involved a total of 825 patients. Table 4 shows the characteristics of the included studies in terms of the study origin, aims, design, intervention, outcome measurements, and main findings. Two of the studies originated from Malaysia, one from Jordan and one from China. Three were RCTs and one was a prospective cohort study. Most of the studies include outcome measurements at a three-month follow-up. The most prolonged study duration was the study by Rosli *et al*. (2021), which had data at a 6-month follow-up. All four studies involved at least one home visit conducted by trained pharmacists. During each visit, the pharmacists reviewed the patients' current medication regime, provided tailored counselling on the disease and its treatment, and performed necessary interventions based on any drug-related issues identified.

Table 4: Characteristics of the included studies.

Authors (Country)	Aim	Study design and duration	Study population	Interventions	Outcome(s)	Measurement tools	Main findings
Chow *et al.* 2016 (Malaysia)	To evaluate whether a home-based intervention can result in a better understanding of T2DM and can increase adherence to prescribed medications.	Randomised controlled trial, April to September 2013. Home-based intervention (HBI) group vs usual care (UC) group.	Adult T2DM patients with HbA1c > 6.5 were prescribed ≥ 3 oral hypoglycaemic agents from a primary healthcare clinic. (Total *n* = 150) (HBI *n* = 75, UC *n* = 75)	A trained pharmacist conducted two home visits. Visit 1 - educational sessions on the proper use of antidiabetic medications. Visit 2 - reinforcement of information from the first visit.	T2DM-related knowledge, medication adherence and glycaemic control at baseline and three months follow-up.	Fourteen-item Michigan diabetes knowledge test (MDKT), eight-item Morisky Medication Adherence Scale (MMAS) and HbA1c measurement.	HBI group was favoured. The mean diabetes knowledge score had increased significantly from 4.19 to 10.0 post-HBI intervention ($p < 0.01$). The mean medication adherence score improved significantly ($p < 0.01$) from 3.53 to 6.90. The mean HbA1c significantly ($p < 0.01$) reduced from 8.92% to 8.19%.
Al-Qudah *et al*. 2018 (Jordan)	To evaluate the impact of Home Medication Management Review (HMMR) on adherence and associated patient factors.	Randomised controlled trial, over 6 months in 2014. HMMR intervention vs control group.	Patients aged ≥18 years old with chronic conditions (e.g. hypertension, diabetes, etc.) were taking ≥ five chronic medications from outpatients of a teaching hospital. (Total *n* = 97) (HMMR *n* = 48, control *n* = 49)	Each patient in both groups received one home visit by an expert clinical pharmacist at baseline. The HMMR group delivered counselling based on self-reported adherence at patients' homes. Therapy-related problems (TRPs) were also identified, and recommendation letters were sent to prescribers.	Patients were assessed for their adherence at baseline and after 3 months.	Medication adherence was assessed using the MMAS questionnaire.	HMMR group was favoured. The medication non-adherence frequencies significantly ($p = 0.027$) decreased from 81.3% to 66.7% in the HMMR group. There was a significant association between the number of TRPs and the level of adherence ($r^2 = 0.348$, $p < 0.001$).

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Table 4: (*continued*)

Authors (Country)	Aim	Study design and duration	Study population	Interventions	Outcome(s)	Measurement tools	Main findings
Rosli *et al.* 2021 (Malaysia)	To evaluate the effectiveness of home medication review by community pharmacists (HMR-CP) in optimising diabetes care and reducing medication wastage.	Randomised controlled trial, March to December 2016. Home Medication Review by community pharmacists (HMR-CP) vs control group.	Adult T2DM patients with the latest HbA1c of more than 6.5% took ≥ five medications for long-term therapy from a primary healthcare clinic. (Total *n* = 166) (HMR-CP *n* = 83, control *n* = 83)	The community pharmacists visited the participants' houses every three months (i.e. at baseline, 3-month, and 6-month follow-up). Tailored counselling was provided about medication adherence, lifestyle modifications and self-monitoring of blood glucose at home.	Patients' clinical variables and anthropometric data, lipid profile, quality of life (QoL) utility value, diabetes knowledge, medication adherence and cost of medication wastage in RM.	Medication adherence was determined based on the pill counting adherence ratio (PCAR). The five-level EuroQol-5 Dimension Questionnaire (EQ-5D-5L) and the Malaysian version of the MDKT were used to assess the quality and diabetes-related knowledge.	The HMR-CP group was favoured. Results showed significant -0.91 reduction in the mean HbA1c (p = 0.004) and –1.62 mmol/L in the mean FBG (p = 0.015). In terms of lipid profile, the TC (-0.34 mmol/L) and HDL (-0.03) reduced significantly (p < 0.05). The mean MDKT (p < 0.001), EQ-5D-5L utility (p < 0.001) and PCAR score (p < 0.001) significantly increased from 10.77 to 13.62 and from 0.2 to 0.51, respectively.
Zhang *et al.* 2022 (China)	To identify and categorise drug-related problems (DRPs) in older adults in China and to assess the impact of home medication review	Prospective cohort study	Patients aged 65 years old and above with chronic medical conditions (i. e. hypertension, diabetes, dyslipidemia, coronary diseases, etc.) and concurrently taking long-term medications from local community health centres. (Total *n* = 412)	Community-based home medication review (CHMR) conducted by trained clinical pharmacists. Any drug-related problems (DRPs) were identified during each home visit. Interventions may be proposed (if any) to the GPs and targeted education on the medication and disease control provided to the patients.	Assessment of DRPs, medication adherence, and health-related quality of life (HRQoL) during each home visit and at 3-month follow-up at the healthcare facility.	Medication adherence was recorded using the Morisky Green Levine Medication Adherence Scale (MGLS). HRQoL was assessed using EQ-5D-5L and EQ-VAS scale.	The mean DRPs identified was 0.88 per patient, with an average of two interventions per DRP. The mean MGLS score significantly reduced from 1.42 to 0.85 (p < 0.001). Significant improvements in the mean EQ-5D (+0.03, p < 0.001)) and EQ VAS (+7.65, p < 0.001) scale were also reported.

Quality Assessment of Included Studies

All included studies were assessed for methodological quality and risk of bias. Three studies were evaluated using the CASP RCTs checklist. At the same time, the CASP cohort/observational checklist was used for the cohort study by Zhang *et al.* (2022). There are three main sections of assessment: study design, methodology and results, and their applicability in local settings. Although some studies did not provide sufficient information on blinding techniques, sample size calculation, confidence intervals and cost analysis, the quality of the included studies were still generally satisfactory.

Overall Findings

The outcomes measured mainly focused on evaluating the patients' diabetes-related knowledge, glycaemic control and health-related quality of life. The primary outcome of interest was medication adherence. Three studies measured the adherence rates using the self-reported medication adherence scales. In contrast, one study utilised the pill counting adherence ratio (PCAR). A summary of different medication adherence scales measured in the included studies is shown in Table 5. The self-reported tool comprised of quick behavioural questions designed to prevent the 'yes-saying' bias frequently observed with chronic care patients. This tool enables the patient to answer inquiries from the clinician concerning non-adherence in a spirit of complete disclosure (Tan, Patel and Chang 2014). There was also a variation in expressions of medication adherence found in the three studies.

Three RCTs in the review provided significant evidence that home medication reviews improved patients' medication adherence. Meanwhile, one cohort study also demonstrated similar results. The summary of documented improvements in medication adherence reported in the four studies is shown in Table 6. All four studies showed statistically significant changes in medication adherence among their participants. It can be noted that in all four studies, the participants received tailored counselling sessions to discuss drug-related problems and education on the proper use of medicines during each home visit.

As for the secondary outcomes, two studies reported significant improvements in glycaemic control with a statistically significant reduction in the percentage of HbA1c post-HMR intervention. Two studies showed the HMR had significantly improved diabetes-related knowledge (Chow *et al*. 2016; Rosli *et al*. 2021). HMR also had been found to improve the quality of life among diabetes patients substantially. Two studies demonstrated statistically significant improvements in the mean EQ-5D-5L scores among the participants (Rosli *et al*. 2021; Zhang *et al*. 2022). The results are outlined in Tables 7 and 8.

Table 5: Types of self-reported medication adherence scales used in the included studies.

Authors	Assessment tool	Questionnaire structure	Full score	Score indicators and reporting mechanism
Chow *et al*. 2016	MMAS	eight-items	8	≥ 6: Low adherence < 6: High adherence
Rosli *et al*. 2021		Yes = 1, No = 0		Adherence reported in terms of mean score

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Table 5: (*continued*)

Authors	Assessment tool	Questionnaire structure	Full score	Score indicators and reporting mechanism
Al-Qudah *et al*. 2018	MMAS	eight-items Never = 0, rarely = 1, sometimes = 2, often = 3, and always = 4	32	< 1: High adherence 1–16: Medium adherence 17–24: Low adherence 25–32: Non-adherence Adherence reported in terms of the percentage of non-adherence pre- and post-intervention
Zhang *et al*. 2022	Morisky Green Levine Medication Adherence Scale (MGLS)	four-items Yes = 1, No = 0	4	High adherence (< 3 points) Low adherence (≥ 3 points) Adherence reported in terms of mean score

Table 6: Changes in medication adherence in the groups receiving pharmacist-led HMR.

Study ID	Measurement tools	Score indicators	Changes in the mean of medication adherence		*P*-value
			Pre-HMR	Post-HMR	
Chow *et al*. 2016	MMAS	Highest adherence (score = 8) and low adherence (score ≤ 6)	3.53	6.90	< 0.001
Al-Qudah *et al*. 2018	MMAS	Percentage of patients with non-adherence scores	81.3%	66.7%	0.027
Rosli *et al*. 2021	PCAR	The higher the ratio, the higher the adherence rate	0.20	0.51	< 0.001
Zhang *et al*. 2022	MGLS	Highest adherence (0 points) and low adherence (3–4 points)	1.42	0.85	< 0.001

Table 7: Summary of methodological quality assessment using CASP checklist for RCTs.

Checklist		Chow *et al*. 2016	Al-Qudah *et al*. 2018	Rosli *et al*. 2021
Section A: Are the results valid?				
Q1	Did the trials address a clearly focused issue?	Yes	Yes	Yes
Q2	Was the assignment of patients to treatment randomised?	Yes	Cannot tell	Yes
Q3	Were all participants who entered the study accounted for at its conclusion?	Yes	Yes	Yes

(continued on next page)

Table 7: (*continued*)

Checklist		Chow *et al.* 2016	Al-Qudah *et al.* 2018	Rosli *et al.* 2021
Section B: Was the study methodologically sound?				
Q4	Were the participants/investigators/assessors 'blind' to intervention they were given?	Cannot tell (no blinding methods)	Yes	Yes
Q5	Were the study groups similar at the start of the randomised controlled trial?	Yes	Yes	Yes
Q6	Apart from the experimental intervention, did each study group receive the same level of care?	Yes	Yes	Yes
Section C: What are the results?				
Q7	Were the effects of intervention reported comprehensively?	Yes	Yes	Yes
Q8	Was the precision of the estimate of the intervention or treatment effect reported?	No (No CI reported)	No (No CI reported)	No (No CI reported)
Q9	Do the benefits of the experimental intervention outweigh the harms and costs?	Cannot tell (No Cost analysis)	Cannot tell (No Cost analysis)	Cannot tell (No Cost analysis)
Section D: Will the results help locally?				
Q10	Can the results be applied to your local population/in your context?	Yes	Yes	Yes
Q11	Would the experimental intervention provide greater value to the people in your care than any of the existing interventions?	Yes	Yes	Yes

Table 8: Summary of methodological quality assessment using CASP checklist for cohort/observational studies.

Checklist		Zhang *et al.* 2022
Section A: Are the results valid?		
Q1	Did the trials address a clearly focused issue?	Yes
Q2	Was the cohort recruited in an acceptable way?	Yes
Q3	Was the exposure accurately measured to minimise bias?	Yes
Q4	Was the outcome accurately measured to minimise bias?	Yes
Q5	Have the authors identified and taken account all important confounding factors?	Yes
Q6	Was the follow up of subjects complete enough?	Yes
Section B: What are the results?		
Q7	How precise are the results?	Cannot tell (No CI reported)
Q8	Do you believe the results?	Yes

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Table 8: (*continued*)

Checklist		Zhang *et al.* 2022
Section C: will the results help localy?		
Q9	Can the results be applied to the local population?	Yes
Q10	Do the results of this study fit with other available evidence?	Yes
Q11	What are the implications of this study for practice?	Cannot tell

DISCUSSION

Literature studies have demonstrated that pharmacists can use helpful techniques such enhanced patient education to better patients' knowledge of the disease and medication adherence (Chow and Hassali 2014). Pharmacists' counselling in inpatient and outpatient settings can further improve medication adherence and persistence (Volino *et al*. 2014). Another study by Taitel *et al.* (2012) reported that community pharmacist face-to-face counselling sessions successfully demonstrate greater adherence and persistence to medication therapy among patients. Motivational interviewing techniques used in pharmacists' counselling can help patients get a new perspective on pharmacotherapy. The new perception allows them to articulate their confidence and commitment to their drug regimes and address any perceived barriers to good adherence.

Besides medication adherence, this review also provides evidence that HMR can significantly improve other aspects of diabetes treatment. These include improved glycaemic control, quality of life, and knowledge of T2DM patients, reducing drug-related problems and the cost of medication wastage. Other advantages of HMR can also include other specific clinical and anthropometric parameters. HMR pharmacists can also educate patients on how to consume correctly, store and dispose of their medications, which is much harder to achieve during busy outpatient clinic hours. Visiting patients in their own homes helps build good relationships with patients, which may further improve adherence.

Study Limitations

The quality of this systematic review is dependent on the quality of evidence from the included studies. Those three RCTs did not mention the details of the actual randomisation process to allocate participants to either the HMR or the usual care group. Therefore, this review's overall positive impact of HMR on adherence should be interpreted cautiously. The four included studies only originated from countries in Asia, which is against generalisation to a global context.

There was also variation in the medication adherence measurement tool used in the four studies. There is no gold standard method to assess medication adherence and every technique has its acceptable error in measuring medication adherence (Goruntla, Mallela and Nayakanti 2019). The heterogeneity in adherence reporting made it inappropriate to conduct a meta-analysis for this review. Additionally, two HMRs were performed by a trained clinical pharmacist, whereas community pharmacists conducted the other two. This fact could also contribute to a variation in the quality of the counselling and information provided to the patients in each setting.

Further Studies

Further studies can support the evidence from this review to substantiate the genuine relationship between the HMR interventions and patients' medication adherence. In-depth interviews or other qualitative study methods can further investigate the non-adherence problem among people with diabetes. This review provides new evidence that pharmacist-led HMR can significantly improve medication adherence in adult T2DM patients. However, it remains unclear whether HMR is the best intervention to tackle the problem. It has been suggested that an appropriate health behavioural model should guide the development of the pharmacist intervention to improve treatment adherence. Such a model should be considered in future intervention programmes (Omran, Guirguis and Simpson 2012). Pharmacists can use the health belief model (Janz and Becker 1984) and the theory of reasoned action (Fishbein 1979) to develop interventions to change a patient's behaviour and encourage medication adherence. Further studies should also explore the cost-effectiveness analysis of conducting the HMR and the healthcare providers' perception of the expansion of such service within the community.

CONCLUSION

This systematic review provided evidence from the recent literature that pharmacist-led HMR interventions can significantly improve medication adherence in adult T2DM patients.

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