# Medication adherence and predictive factors in patients with cardiovascular disease: A comparison study between Australia and Iraq

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## Abstract

***Background:*** Adherence to cardiac medication regimes is essential for effective treatment of cardiovascular disease but is unsatisfactory in Australia and little studied in Iraq.

***Aim:*** This study evaluated and compared adherence to cardiac medications and potentially predictive factors based on the Theory of Planned Behaviour (TPB) in patients with cardiovascular disease admitted to hospital and attending cardiac services in Australia and Iraq.

***Methods****:* A cross-sectional multi-centre comparative study involving 246 cardiac patients was conducted in Australia (one hospital in Sydney) and Iraq (three cardiac hospitals in Baghdad) between October 2016 and December 2017. Adherence to medications and related factors were examined using established, validated questionnaires, formally translated and validated into Arabic for Iraqi participants. Binary logistic regression was conducted to determine those factors independently predictive of cardiac medication adherence, in Australia and Iraq.

***Findings:*** A significantly higher proportion (64.3%) of Iraqi than Australian (37.5%) cardiac patients reported medium/low levels of adherence to their cardiac medications. After adjusting for confounding factors, the ability to correctly self-administer and refill medications, and beliefs about cardio-protective medication were identified as independent predictors of cardiac medication adherence behaviour in both Australian and Iraqi participants. In Iraq, patients recruited from out-patient cardiac clinics were

significantly more likely to report adherent behaviours than patients recruited as in-patients of the cardiac ward.

***Conclusion:*** Non-adherence to cardiac medications differed but was sub-optimal in both Australian and Iraqi patient samples, in both countries, adherence was associated with patients' beliefs about medications, and ability to self-administer and refill medications. Clinical nurses and pharmacists need to investigate these factors at every point in the cardiac trajectory to optimise medication adherence.

**Keywords**: Cardiovascular disease, Australia, Iraq, cardiology, medication adherence, beliefs, medication refill, cardiac nursing, theory of planned behaviour.

**Summary of Relevance**

**Problem**

Cardiovascular disease remains the major cause of mortality in developed and developing countries.

**What is already known:**

Cardiovascular medication adherence is suboptimal, increasing the risk of morbidity. Few medication adherence investigations have been conducted in Australia and none have been published from Iraq.

**What this paper adds:**

This is the first study to compare adherence to cardiac medications and factors potentially predictive of medication non-adherence in patients with cardiovascular disease in Australia and Iraq. Outcomes can support the development of nurse-led behavioural approaches to improve medication adherence in patients with cardiovascular disease. Findings flag the importance for nurses should focus on patients' beliefs about their medication and their ability to self-administer and refill medications, taking into account the socio-eco-cultural factors on medication adherence.

## 1. Introduction

Cardiovascular disease (CVD) is the major cause of death in both developed and developing countries (Wirtz, Kaplan, Kwan, & Laing, 2016). CVD encompasses a variety of disease entities and specific symptom complexes, treated by a variety of approaches, pharmaceutical, surgical and interventional radiology. In developed countries, the annual mortality associated with CVD in 2013 was 4 million people, with more than 1.4 million dying prematurely before the age of 75 years (Townsend et al., 2016). In Australia, CVD accounts for 18% of the total burden of disease and was responsible for 43,963 deaths in 2016 and more than 490,000 hospital admissions in 2014-2015 (Heart Foundation, 2016). According to the Australian Pharmaceutical Benefits Scheme (PBS), the total cost of CVD medications in 2015-16 was AU$1.448 billion for a total estimated population of 23.781.200 people (Australian Bureau of Statistics, 2015), comprising 20% of the total health expenditure (Australian Institute of Health and Welfare, 2017).

Prevalence rates of CVD are increasing, and particularly in Middle Eastern countries such as Iraq, where CVD accounted for 27,500 deaths in 2012, 16.5% of all-cause mortality (World Health Organization, 2013). The Iraqi government subsidises the cost of a wide range of prescription medicines, including those for CVD. Government health expenditure was US$82.2 billion in 2010 with an estimated 39% spent on cardiovascular medications, totalling around US$32 billion for a population of 30.868.156 people (Al Hilfi, Lafta, & Burnham, 2013). The standard of treatment and care remains suboptimal in Iraq and the health care system is poorly effective in managing long-term disease such as CVD (Alwan, 2004).

Long-term management of CVD is largely based on life-style modifications such as diet, physical exercises, smoking cessation and medications are usually required over sustained periods, often for life (Australian Institute of Health and Welfare, 2017). Hence, adherence to medication regimes and the ability to maintain treatment as prescribed is essential to managing symptoms, delaying or preventing disease progression, premature disability and death (World Health Organisation, 2003). Unless patients living with CVD are able to maintain treatments as prescribed, the resources committed

by the pharmaceutical industry and healthcare providers to drug development, diagnosis and prescription are wasted.

## 2. Background

Medication adherence is defined as the extent to which patients take medications as prescribed by their health care providers (World Health Organisation, 2003). Poor medication adherence is a key factor impeding disease control among those with CVD (World Health Organisation, 2003). Despite evidence of the effectiveness of cardiac medications such as anti-platelet agents, beta-blockers, angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), and aldosterone receptor antagonists (ARA) (Levy, Huang, Huang, & Michael Ho, 2018) to manage CVD symptoms, non-adherence rates range from 44.4% to 61% across settings and countries (Paradkar & Sinha, 2017). Studies report that adherence to cardio-protective medications is sub-optimal in both resource-limited and resource-rich countries (Chowdhury, Khan, & Heydon, 2013). This is a major problem internationally; as such, there may be lessons to learn from multi-national comparisons, studying the problem in different settings and contexts.

Long-term cardiac medication adherence by Australian patients with CVD is unsatisfactory, with non-adherence rates ranging between 14% and 43% from 2010 to 2014 (McKenzie, McLaughlin, Clark, & Doi, 2015). To date, few investigations of medication adherence have been conducted with Australian patients with chronic conditions, especially patients with CVD, and no published studies report adherence to cardiovascular medications in Iraq. Many medication adherence studies have been conducted in developed countries, but it is difficult to extrapolate the results of these studies to developing countries such as Iraq due to disparities in healthcare systems, social and cultural factors that affect health beliefs and practice (Sharrad, Hassali, & Shafie, 2009). Medication non-adherence is a complex and multi-faceted problem, influenced by a wide range of sociodemographic and economic characteristics, behavioural and cognitive problems, medication complexity and social support systems (Marshall, Wolfe, & McKevitt, 2012). Cultural differences among patients from diverse national backgrounds, racial and ethnic groups may contribute to disparities of cardiovascular medication adherence (Traylor, Schmittdiel, Uratsu, Mangione, & Subramanian, 2010). Cultural differences can

negatively influence patients' beliefs about medication and their perceptions of treatment, and difference in generation, household composition and religion may also create variability in beliefs and behaviours (Horne et al., 2004). Multiple different factors may, therefore, contribute to medication non-adherence in developed and developing countries (Cooney et al., 2009).

In patients with CVD, negative perceptions of medications (Choudhry et al., 2011), beliefs about benefits and harms of medications (Horne et al., 2013), low levels of social support (Park, Howie-Esquivel, Whooley, & Dracup, 2015), low self-efficacy (Greer, Milner, Marcello, & Mazin, 2015), poor medication self-management, attitudes and sociocultural norms (Martin, Williams, Haskard, & DiMatteo, 2005) and problems refilling medications have all been found to influence adherence to cardiac medications (Kripalani, Risser, Gatti, & Jacobson, 2009). Other contributing factors include the complexity of treatment, patients' forgetfulness (Karakurt & Kaşikçi, 2012), the presence of comorbidities (Al Qasem, Smith, & Clifford, 2011) and medication side effects (Molloy & O'Carroll, 2017).

At an individual level, the engagement of individuals in health-related behaviours, such as medication adherence, may be explained by applying behavioural theories. This study used Ajzen (1991) Theory of Planned Behaviour (TBP) to identify factors predictive of medication adherence in patients with CVD (Figure 1). The TBP encompasses attitudes (e.g. positive or negative beliefs about the behaviour), subjective norms (e.g. the degree to which social consensus values and role models reinforce behaviours; perceived social support to perform the behaviour), and perceived behavioural control (e.g. perceptions of self-efficacy to perform the behaviour) (Table 1). The theory explains how these factors might impact patients' intentions or directly influence their behaviours such as adherence to cardiac medications (Armitage & Conner, 2001).

The social and cultural contexts of Australia and Iraq differ, as developed and developing nations of the West and the Middle East. However, both have high prevalence rates of CVD, and for both it is crucial to understand adherence to CVD medications and factors which predict this. Cross-national comparisons might offer information, for example cultural insights, not available with a single

country study. The aim of this study, therefore, was to explore medication adherence behaviours of patients with CVD, admitted to hospital and attending out-patient services, in Australia and Iraq and to determine factors predictive of adherence to cardiac medications regimes. Findings could inform development of preventive strategies to improve medication adherence internationally through tailored nurse-led adherence interventions utilising reliable adherence assessment tools and the most effective and appropriate adherence approaches.

## 3. Methods

### 3.1 Aims and objectives

The aim of this study was to evaluate and compare adherence to cardiac medications and factors potentially predictive of this in patients with CVD in Australia and Iraq.

Objectives were to:

1) Identify and compare the levels of cardiac medication adherence in patients with CVD in Australia and Iraq.

2) Examine and compare socio demographic, health related, attitudinal and behavioural factors potentially predictive of medication adherence in these countries using the lens of the Theory of Planned Behaviour (TPB) (Ajzen, 1991).

### 3.2 Design

This was a cross-sectional multi-centre comparative study conducted in Australia (one hospital in Sydney) and Iraq (three cardiac hospitals in Baghdad). Survey design was used to explore cardiac patients' medication adherence.

### 3.3 Study settings

In Australia, participants were recruited from the in-patient cardiology ward and out-patient cardiac rehabilitation centre of an acute tertiary hospital in Sydney. This hospital has inpatient diagnostic and interventional cardiac services including a cardiothoracic intensive care and sub-acute

surgical ward, a coronary care unit and sub-acute cardiology ward. The out-patient cardiac rehabilitation service screened in-patients and external referrals for delivery of cardiac rehabilitation programs including structured, supervised group exercise and information sessions, and referral to relevant services.

In Iraq patients were recruited at three cardiac hospitals in Baghdad, Iraq. These were major tertiary teaching hospitals offering a range of cardiac services including cardiac out-patient clinics and in-patient cardiac services for approximately 570 beds with intensive and coronary care units, cardiology and cardiac surgery departments. These three public hospitals are operated by the Iraqi Ministry of Health, which provides cardiac services for people referred nation-wide, including cardiac emergency and critical care cases. At the time of this study, most Iraqi hospitals were struggling to recover from years of war, shortages in health facilities and the health workforce, with inadequately trained healthcare professionals and poor health-care finance (The Iraqi Ministry of Health, 2012).

### 3.4 Participants, sampling and sample size

Participants were patients who had been admitted to hospital for an acute cardiac event or referred to and attended a cardiac rehabilitation program or out-patient cardiac clinic between October 2016 and December 2017. Similar inclusion criteria were applied in both countries: 18 years of age or older; diagnosed with cardiac disease; currently taking at least one cardio-protective medication and having primary responsibility for taking their own medication before admission to hospital or when attending cardiac rehabilitation. Participants were required to be able to read, speak and understand English (in Australia) or Arabic (in Iraq). Patients who were blind, deaf or medically deemed unable to provide consent were excluded. Patients in the cardiac ward were excluded if they were newly diagnosed with no previous history of cardiovascular disease and hence no prior history of taking prescribed cardiac medication.

Recruitment occurred under the supervision of the clinical nurse consultant for cardiac rehabilitation and the clinical pharmacist for the cardiac ward in Australia and the clinical nurse specialist for all sites in Iraq, with the agreement of the directors of nursing and the cardiology

consultants of both sites. Patients were screened using the study inclusion/exclusion criteria by the clinical nurse consultant/specialist and the clinical pharmacist. Eligible members of consecutive cohorts of patients who expressed interest in the project were referred to the researcher. In Australia, approvals to conduct this study were granted by the appropriate health district and university Human Research Ethics Committees in June 2016 (references: 16/085 (16/085 -HREC/16/POWH/218; ETH16-0635), and the health district Human Research Ethics Committees from the three hospitals in Iraq approved the study in June 2017. Participants' privacy and confidentiality was maintained at all times and informed consent obtained from all participants.

### 3.5 Sample size determination

A sample size of 120 participants in each country was calculated to demonstrate a moderate sized effect ($\alpha = 0.05$, 5% level of significant) and power = 0.80 (Ma, Zhou, Zhou, & Huang, 2014). We anticipated approximately 50% of eligible patients might participate.

### 3.6 Data collection procedures

In order to assess medication adherence and associated factors, a valid, reliable and culturally acceptable instrument is required. Data collection procedures at both sites were performed under the same methods and conditions using the same instruments for the respective language after formal translation procedures had been performed in Iraq.

In both Australia and Iraq, data collection took place during patients' stay in the inpatient cardiac ward, during attendance at cardiac rehabilitation sessions, or when visiting an outpatient clinic. The study used a paper-based self-report questionnaire. At enrolment, participants received a survey package including an information sheet, a consent form and the study instruments. The researcher also verbally explained the purpose and methods of the study face-to-face.

### 3.7 The survey

The survey comprised a number of validated questionnaires designed to gather data about medication adherence, patient beliefs, behavioural, attitudinal and other factors associated with

adherence/non-adherence. For Iraqi participants, all questionnaires were formally translated and validated in the Arabic language using best practice translation guidelines (Sousa & Rojjanasrirat, 2011).

Study instruments were translated into Arabic and then back-translated to English by two researchers independently (Epstein, Santo, & Guillemin, 2015). The researcher used the back-translation method for achieving linguistic translations equivalent to the items in the source language (Duffy, 2006). Following the instrument translation recommendations, an expert translator translated the English versions of the questionnaires into Arabic. The Arabic translated version was then back-translated to English by an independent expert with rich clinical experience in cardiology nursing, bilingual and fluent in both English and Arabic languages but unfamiliar with the study. The researcher then discussed and resolved minor rewording conflicts. All translations were conducted using clear, direct and simple phrases and questions suitable for older adults with low literacy levels. Content and face validity of the study questionnaires were assessed and confirmed by seven content experts with extensive experience in cardiac disease of various specialty backgrounds (cardiologist, senior pharmacists, cardiac nurse specialist and nursing educators). They reviewed the questionnaires using the Content Validity index, resulting in the wording of some items being slightly revised. The translated questionnaires were piloted with five cardiac patients from the three Iraqi hospitals; further minor modifications were made so the questionnaires could be easily understood. Sociodemographic and health data were collected, and completion took 10-15 minutes (Table 2).

### 3.7.1 Medication adherence questionnaire

The Medication Adherence Questionnaire (MAQ) scale (Morisky, Green, & Levine, 1986), is a short, self-reported measure designed to assess medication adherence behaviour and barriers such as forgetfulness, carelessness, adverse effects and efficacy. It contains four simple dichotomous questions (yes/no), scoring one point for each “yes” response and zero point for each “no” response. Scores are summed to derive a total score with higher numbers demonstrating greater medication non-adherence i.e. 0 =high to 3-4= low medication adherence behaviours. The validity and reliability of the MAQ was

originally established in patients with hypertension, with internal consistency of $\alpha = 0.61$, sensitivity of 0.81 and specificity of 0.44 (Lavsa, Holzworth, & Ansani, 2011). The MAQ score has been demonstrated to be a significant independent predictor of cardiovascular medication nonadherence by multivariate logistic regression (Shalansky, Levy, & Ignaszewski, 2004).

### 3.7.2 The adherence to refills and medications scale

The 12-item scale Adherence to Refills and Medications Scale (ARMS) (Kripalani et al., 2009) was used to determine medication adherence self-regulation. The ARMS consists of 12-items, the first 8 items in the scale assessing the ability to self-administration for the prescribed medications and the last 4 items evaluating the patient's ability to take medications on schedule. Each item is scored on a four-point scale ranging from l = none of the time to 4 = all the time. Scores are summed to derive a total score with higher numbers demonstrating better refill ability for medications on schedule. The ARMS and its subscales have been shown to correlate highly with other measures of medication adherence such as the four-item scale by Morisky and colleagues, and medication refill adherence (Mayberry, Gonzalez, Wallston, Kripalani, & Osborn, 2013). The ARMS has demonstrated high internal consistency among patients with low literacy skills (Kripalani et al., 2009).

### 3.7.3 The belief about medicine questionnaire

The short (eight-item) version of the Belief about Medicine Questionnaire (BaMQ) (Horne, Weinman, & Hankins, 1999) was used to evaluate patients' beliefs about medications. The BaMQ identifies patients' beliefs in the necessity of and concerns about their medicines. The BaMQ is composed of subscales (8 items) to assess specific necessity, specific concerns, general overuse and general harm. Each item is measured using a 5-point Likert scale range from l = strongly disagree to 5 = strongly agree. Scores are summed to derive a total score with higher numbers demonstrating more positive beliefs. The internal consistency of the BMQ scale has been evaluated using Cronbach's alpha, showing inter-item correlation of General Harm= 0.44, $p < 0.01$); General Overuse= 0.64, $p < 0.01$); Specific Necessity= 0.79, $p < 0.01$); and Specific Concerns = 0.56, $p < 0.01$) (Schüz et al., 2011). The BaMQ has been shown to correlate significantly with other adherence-related scales such as the MAQ,

253 the Morisky Medication Adherence Scale (MMAQ), and medication adherence rating scale (MARS-5)
254 (Mårdby, Åkerlind, & Jörgensen, 2007).

255 **3.7.4 The medication adherence self-efficacy scale-revised**

256 The 13-item Medication Adherence Self-Efficacy Scale-Revised (MASES-R) (Fernandez,
257 Chaplin, Schoenthaler, & Ogedegbe, 2008) was used to evaluate an individual's ability to adhere to
258 their medication schedule under various challenging circumstances. The MASES-R consists of items
259 that specifically examine patients' confidence in taking medications in specific circumstances and their
260 ability to take medications as part of everyday routine. Each item is measured using a 4-point Likert
261 scale, ranging from 0 = not at all sure to 3 = extremely sure, with greater self-efficacy indicated by
262 higher scores and a single score derived as the mean of all items. The MASES-R has been found
263 correlate to significantly with electronic medication adherence records (MEMS) at 3-months, indicating
264 support for the predictive validity of the MASES-R (Fernandez et al., 2008).

265 **3.7.5 Medication specific social support**

266 An eight-item Medication Specific Social Support (MSSS) scale (Lehavot et al., 2011) was
267 used to identify how often patients receive assistance from others with their medication. Each item is
268 measured using a 5-point Likert score for each item ranging from 0 = never to 4 = very often., with a
269 high total mean of all items representing a high level of medication-specific support.

270 **3.8 Data analysis**

271 Data were checked and cleaned prior to entry into SPSS for Windows version 23. Descriptive
272 statistics were used to analyse data related to the patients' baseline characteristics in Australia and Iraq,
273 level of medication adherence, medication adherence self-efficacy, beliefs about medication and social
274 support. Optimal adherence was defined as having a score of greater than two on the four-item Morisky
275 medication adherence scale. Bivariate analyses were conducted using the Spearman Correlation
276 Coefficient to examine factors potentially associated with medication adherence. The levels of
277 medication adherence were categorised as high and low/medium and compared between the

two patient groups by Chi-square ($\chi 2$) test. Variables significantly associated with medication adherence in bivariate analyses were examined by logistic regression, with significance set at $P < 0.25$ in the preliminary bivariate analysis for entry into regression models and $P < 0.05$ for the regression analysis (Polit., 1996). Two sided tests were conducted and for all analyses, p values of <0.05 were considered statistically significant.

## 4. Results

### 4.1 Characteristics of participants

Recruitment progressed at approximately 13 participants per month in a single general hospital in Australia and 20 participants per month at three specialised cardiac hospitals in Iraq. Between October 2016 and December 2017, in total 246 patients with CVD were recruited, n=120 in Australia, n=126 in Iraq, as: a) in-patients of a cardiac ward (n = 179) and b) out-patients attending cardiac rehabilitation in Australia and out-patient clinics in Iraq (n = 67).

The characteristics of participants from Australia and Iraq are presented in Table 2. Sociodemographic, health and medication-related continuous data were provided by means and standard deviations, and categorical data by frequencies and percentages. Differences between patients from Australia and Iraq were tested using independent samples t-tests for continuous variables and Chi-square ($\chi 2$) test for categorical variables. Overall, Iraqi cardiac participants were significantly younger (t=9.82, p= 0.001) and more likely to be unemployed ($chi^2$= 71.52, p=0.017), married or in a co-habiting relationship ($chi^2$= 30.35, p=0.001). They were also significantly more likely to have a lower level of education ($chi^2$= 26.49, p=0.001), comorbid disease ($chi^2$= 10.90, p=0.001), and to take significantly more and different classes of cardiac medications per day than Australian cardiac participants (t= -5.71, p=0.001).

### 4.2 Medication adherence

Significantly more participants from Iraq reported medium/low levels of adherence to their cardiac medications compared to participants from Australia (64.3% versus 37.5%, respectively) and

fewer reported high levels of adherence to their cardiac medications than participants recruited in Australia (35.4% versus 62.5%); both $p = 0.001$ (Table 3). Significant associations were sought between socio-demographic and medication-related variables and medication adherence (Tables 4). In neither country were the sociodemographic or health variables significantly associated with medication adherence.

The ARMS included 12-items measuring the ability to self-administer prescribed medications and evaluating the patient's ability to take medications on schedule. Mean scores for the ability to self-administer medications for the Australian participants (ranging from 23-40) and the Iraqi participants (ranging from 20-40) were 38.05 (SD=2.69) and 33.72 (SD=4.98), respectively (Table 5). Mean scores for the ability to refill medications on schedule (the last 4 items) for the Australian and Iraqi participants (ranging from 8 to 16) were 14.95 (SD=1.26) and 12.64 (SD=2.21), respectively. Mean scores for the ability to refill medication were highest in the Australian participants for the item "How often do you put off refilling your medicines because they cost too much money?" (mean= 3.94, SD= 0.23) and in Iraqi participants for the item "How often do you decide not to take your medicine?" (mean= 3.59, SD= 0.68). Lowest reported mean scores for both Australian and Iraqi participants were for the item "How often do you plan ahead and refill your medicines before they run out?" (mean=3.43, SD= 0.9; mean=3.25, SD= 0.75, respectively) (Table 5).

The BaMQ is composed of 8 items comprising subscales to assess specific necessity, specific concerns, general overuse and general harm. For Australian and Iraqi participants, mean scores for beliefs about the necessity of medications (ranging from 18 to 49 and 8 to 49, respectively) were 44.33 (SD=6.14) and 34.57 (SD=11.05), respectively. Mean scores for concerns about medication were 5.05 (SD=2.10) and 5.66 (SD=2.11), respectively. Mean scores about beliefs about the overuses of medication were 4.45 (SD=1.73) and 5.62 (SD=2.14), respectively. Mean scores about beliefs about the harms of medication were 4.13 (SD=1.45) and 4.88 (SD=2.24), respectively (Table 5). In this scale, most positive beliefs (highest scores) were reported for the item "My medicines protect me from becoming worse" (mean=4.6, SD=0.67; mean=4.25, SD=0.71 for Australian and Iraq participants, respectively). Lowest scores were reported for the item "People who take medicines should stop their

330 treatment for a while every now and again" (mean=1.83, SD=0.91) for Australian participants, but.
331 the item "Medicines do more harm than good" had the lowest reported scores (mean=2.37, SD=1.19)
332 amongst Iraqi participants.

333 The medication adherence Self-Efficacy Scale-Revised consists of 13-items to assess patients'
334 confidence in taking medications and their ability to take medications as part of everyday routine.
335 Mean MASES-R scores (ranging from 8 to 39) for Australian participants was 35.2 (SD= 5.78) and
336 (ranging from 5 to 39) for the Iraqi participants was 27.1 (SD= 8.92) (Table 5). The highest score
337 reported for the item "I feel confident to make taking my medicines part of my routine" for both
338 Australian and Iraqi participants (mean= 2.84, SD= 0.43; mean= 2.33, SD= 0.85), respectively. For
339 Australian participants, lowest scores were reported for the item "I feel confident taking my medicine
340 when I worry about taking them for the rest of my life" (mean= 2.57, SD= 0.77); for Iraqi participants,
341 the item "I feel confident taking my medicine when I feel well" (mean= 1.90, SD= 1.07) was scored
342 lowest.

343 Mean scores for the Medication Specific Social Support scale (ranging from 0 to 32) for the
344 Australian sample were 11.42 (SD= 7.02) and (ranging from 0 to 40) for the Iraqi sample was 10.57
345 (SD= 9.13) (Table 5). The highest scored item by the Australian group was "How often has someone
346 in the past helped you understand information about your medicines?" (mean= 1.86, SD= 1.19), but
347 for the item "How often has someone in the past picked up your cardiac medicines prescriptions for
348 you?" in the Iraqi group (mean= 2.69, SD= 1.3). The lowest scored item was "How often has someone
349 in the past called you specifically to ask how you were doing with your cardiac medicines?" for both
350 Australian and Iraqi participants (mean= 0.87, SD= 1.24; mean= 1.61, SD= 1.69, respectively).

351 Binary logistic regression analysis was used to assess the predictors of medication adherence
352 examining the samples from both countries together and separately. After adjusting for confounding
353 factors, five potential predictors including age, location of recruitment (cardiac ward versus cardiac
354 rehabilitation or outpatient clinic), ability to correctly self-administer and refill medications, medication
355 adherence self-efficacy and beliefs about medication were included in the models. For the combined
356 sample, country of origin was also added (Table 6) but was not found to exert significant effect. In all
357 the models, patients' ability to correctly self-administer and refill their medications was significantly

predictive of their reported adherence behaviours (Tables 6, 7a, 7b). In the Australian model (Table 7a), beliefs about medications made a small additional significant contribution (odds ratio= 1.142, 95% CI: 1.005-1.298, p= 0.041). In the Iraqi sample (Table 5b), beliefs about medications (odds ratio= 1.224, 95% CI: 1.090-1.375, p= 0.001) as well as location of recruitment (cardiac ward versus cardiac clinics) were also significantly predictive, with patients recruited from an out-patient cardiac clinic significantly more likely to report adherence that patients recruited in a cardiac ward (odds ratio= 0.300, 95% CI: 0.093-0.966, p= 0.044) (Table 7b).

All the models recorded significant Omnibus tests ($p < 0.001$). In the combined sample model, the Pseudo R Square statistic indicated that the model as whole explained 39.4% (Cox and Snell R Square =0.394) and 52.5% (Nagelkerke R Square = 0.525) of the variance in cardiac medications adherence. ARMS + BaMQ explained 39.6% of variance but ARMS alone explained 36.6% of variance in MAQ. In the separate Australian and Iraqi samples, the Pseudo R Square statistic indicated that the models as whole explained between 38.7% versus 42.6% (Cox and Snell R Square =0.387 versus 0.426) and 52.8% versus 58.5% (Nagelkerke R Square = 0.528 versus 0.585, respectively) of the variance in cardiac medications adherence, respectively.

## 5. Discussion

To our knowledge, this is the first study to report and compare adherence to cardiac medications and associated factors in patients with CVD in Australia and Iraq. Based on our findings, self-reported adherence to cardiac medications in both Australian and Iraqi patients with CVD was far from optimal. Adherence to cardiac medications was suboptimal in Australian patients, with 37.5% not achieving reasonable levels; similar problems have also been reported in cross-sectional survey of patients with chronic disease in Australia (Laba, Lehnbom, Brien, & Jan, 2015). In developed countries, long-term medication adherence for chronic diseases has been reported to range from 30%-70% of treated patients (Degli Esposti et al., 2012). Non-adherence has been reported by 39% of Italian patients with ischaemic stroke (Colivicchi, Bassi, Santini, & Caltagirone, 2007) and by 38.3% of Canadian patients with heart failure (George & Shalansky, 2007). The results of a meta-analysis indicated unsatisfactory long-term

cardiac medication adherence in Australian patients with CVD, with prevalence rates of medication non-adherence ranging between 14% and 43% in 2010 to 2014 (McKenzie et al., 2015).

Compared to developed countries, in developing countries medication adherence rates have been generally reported as lower (Ma, 2016), reflected in our findings where Australian patients were significantly more likely to have high adherence compared to patients from Iraq. These findings align with other studies from other developing countries: non-adherence was reported by 41.5% of patients with hypertension in southwest Nigeria (Osamor & Owumi, 2011) and 51.5% of patients with CVD in Kyrgyzstan (Murphy, Jakab, McKee, & Richardson, 2016). Similarly, 54.2% of Palestinian patients with hypertension (Al-Ramahi, 2015) and 58.1% of Malaysian patients with CVD (Khonsari et al., 2015) were non-adherent. Our study showed suboptimal adherence levels for a significant proportion of the cohorts in both countries, indicating the need for urgent attention. Study findings demonstrated significant differences in sociodemographic characteristics between Australian and Iraqi samples. However, none of the sociodemographic characteristics were found to be statistically associated with medication adherence. In comparing the two countries, major differences in socioeconomic development and health disparities may be reflected between the two groups as developed and developing countries. The healthcare system in Iraq, including cardiac disease management, is in early stages of development, which may relate to the low rates of adherence to cardiac medications seen in this study. The cultural implications and perceptions about taking medications may differ between developed and developing countries in terms of knowledge, attitudes and beliefs, and these may underpin medication adherence behaviours, especially for ethnic minority groups (Alzubaidi, McMamara, Chapman, Stevenson, & Marriott, 2015). Likewise, cultural differences in the understanding of chronic disease and the role of therapy, healthcare attendance, and the interactions between patients and healthcare professionals in developed and developing countries may profoundly influence the prevalence of medication adherence (Bowry et al., 2011). Further studies are required to add detail to the patterns of non-adherence in relation to specific cardiac medications in Australia and Iraq, and then to promote interventions in frontline cardiac care settings, testing their ability to enhance adherence to medications and to have significant impact on morbidity and mortality rates.

411 **5.1 Factors associated with medication adherence**

412 There is currently limited knowledge of factors associated with medication non-adherence in
413 patients with CVD, with little work exploring knowledge, attitudes, beliefs and related behaviours
414 (Crowley et al., 2015). In both Australia and Iraq, analysed as a combined sample or individually for
415 each country, the ability to correctly self-administer and refill medications significantly ($p<0.001$)
416 predicted adherence behaviours. This suggests major behavioural drivers may be similar across
417 countries despite cultural differences. These findings are consistent with the results of previous studies
418 with other patient groups, such as Swiss patients with hypertension (Zeller, Taegtmeyer, Martina,
419 Battegay, & Tschudi, 2008), American patients on warfarin therapy (Orensky & Holdford, 2005) and
420 patients with CVD in Canada (Reidel, Tamblyn, Patel, & Huang, 2008), where the ability to refill
421 medication independently predicted adherence behaviour but with the association declining with
422 increasing regimen complexity.

423 The elements of the TPB conform to and define the ability to refill cardiac medication and
424 beliefs about medication as attitudes and behaviours that predict greater medication adherence and
425 mediate the relationship between treatment and medication adherence. Poorer ability to self-administer
426 and refill medications can be due to poor patient knowledge about treatments, particularly in older
427 patients (Ratanawongsa et al., 2013); to cognitive dysfunction (Platt et al., 2008), low social support
428 (Park et al., 2015) and lower economic status (World Health Organisation, 2003). Healthcare
429 professionals should ensure that all patients have adequate knowledge, skills and understanding in self-
430 administration of their medications. This is particularly important in older populations, as these skills
431 may tend to decline with age and increase with forgetfulness.

432 In addition, in the current study, beliefs about medication were a significant predictor of cardiac
433 medication adherence: findings that provide further support to the Theory of Planned Behaviour.
434 According to this theory, individuals' beliefs are strong predictors of their intentions and possibly of
435 actual health behaviours such as medication adherence (Ajzen, 1991). This study findings are in line
436 with the TPB proposition that medication adherence intention can be influenced by patient attitudes
437 toward adherence behaviour, which can be determined by their beliefs about the necessity of performing

this behaviour (Redding, Rossi, Rossi, Velicer, & Prochaska, 2000). The behavioural intention of medication adherence might also be influenced by factors which may be beyond an individual's control, including ability to refill medications and their psychosocial and health characteristics.

These findings are congruent with those of Ruppar, Dobbels, and De Geest (2012) who found that stronger belief in the necessity of antihypertensive medications could predict better adherence among American patients (OR= 2.027, $P = 0.024$; CI: 1.097-3.645). Similarly, in patients with negative beliefs about the necessity of their medications, non-adherence rates were double that of those with less negative beliefs (Gatti, Jacobson, Gazmararian, Schmotzer, & Kripalani, 2009). These patients were more likely to intentionally skip doses and report forgetfulness (World Health Organisation, 2003). Similar findings have been reported in studies conducted in Oman, where stronger beliefs about the necessity of hypertensive medications were significant predictors of medication adherence (Al-Noumani et al., 2017).

Studies have suggested that patients' ability to self-administer and refill medications and their beliefs about medications may be affected by their level of education (Park et al., 2015), the number of prescribed medications (Karakurt & Kaşikçi, 2012) and comorbid conditions (Molloy & O'Carroll, 2017). Given the differing national contexts and variation in the sociodemographic characteristics between the Australian and Iraqi groups, differential effects might have been anticipated. However, no sociodemographic or health related factors retained significance in multivariate modelling to predict medication adherence. The similarity of the findings from the two countries are striking; despite their very different cultures, independently predictive variables showed little difference. Further research is required to fully understand the perceived barriers to refilling medication, detail of beliefs and confidence to take medication.

Study findings indicated that the location of recruitment in relation to CVD services (cardiac ward versus cardiac clinics, a proxy for differing time points in the cardiac patient journey) was a significant predictor of medication adherence among Iraqi patients, with more participants from the cardiac ward having medium/low adherence than those recruited as out-patients. It might have been anticipated that patients admitted for an acute cardiac event might report worse medication adherence

than patients seen as out-patients, who might reasonably be expected to be more clinically stable. However, this pattern was not seen in patients recruited in Australia. No research has previously examined the relationship between cardio-protective medication adherence and service provider location/cardiac patient journey time point in Iraq, where poor adherence with cardiovascular medications might be attributed to CVD service deficiencies both for in-patients and out-patients (Kronish & Ye, 2013). Another possible explanation might be that patients' opportunities to attend cardiac clinics were less in Iraq, with those attending being generally more motivated, perseverant, and willing to attend follow-up with their cardiologists, with consequently relatively better medication adherence (Bedell et al., 2000). Perhaps more medication education was delivered in the out-patient clinics than in the cardiac wards in Iraq, but with less variation in Australia. The study findings highlight the importance of patient education and medication related knowledge to enhance adherence behaviour in cardiac ward before patient discharge, in out-patient clinics and cardiac rehabilitation settings (Curl et al., 2016). Iraqi patients with CVD might have experienced particular problems in accessing quality health services due to the lack of or limited resources which might include provision of medications in public hospitals. This study reveals the need for nursing educational interventions to not only educate patients on their medications and send out reminders but also address patients' beliefs about their medications and their ability to self-administer and refill medications.

### 5.2 Limitations of the study

This study is attended by a number of limitations. Although medication adherence self-reports are useful and have been shown to be reasonably accurate measures of medication adherence, this approach can be susceptible to information and social desirability bias (Morisky & DiMatteo, 2011). Further, our adherence measure did not distinguish between specific cardiac medication classes but rather medication adherence behaviour generally (Crowley et al., 2015). For many of those tools, particularly the MAQ, there are to date only limited validation and reliability data available, which may limit confidence in their ability to accurately indicate patients' adherence to their medications. Cardiac patients' beliefs about medication and their ability to refill cardiac medication

may have been influenced by the type of cardiac medications taken by study participants due to differences in side effects and cost. The differences in sociodemographic characteristics and some health-related variables between Australian and Iraqi samples may limit the interpretation of the comparative findings. Future research should include and recognise different classes of cardiac medications. Data were collected utilising convenience sampling from three different hospitals in Iraq and one hospital from Australia. Convenience sampling from multiple sites may have allowed the sample to better represent these populations with regard to demographic characteristics. Finally, longer-term follow-up would add valuable information about the sustainability of medication adherence behaviours across the cardiac patient journey.

## 6. Conclusion

The findings of this cross-sectional study are unique in terms of comparing cardiac medication adherence behaviours between patients from developed and developing countries: Australia and Iraq. The study results sought to inform new behavioural nurse-led approaches to improve medication adherence in patients with CVD. For the future such behavioural interventions should include ability to refill medications and address medication-related beliefs to encourage medication adherence. Further follow up study is needed in both Australia and Iraq, where strategies should be tailored to target these factors that have been shown to predict patients' adherence behaviours across cultures and settings/disease time points. New interventions are urgently required to improve the unacceptably poor medication adherence in both Australia and Iraq.

The findings of this study have crucial implications for nursing practice, education, policy and future research. Findings indicate that nurses should focus on exploring patients' beliefs about their medications and promote accurate knowledge of cardiac medications. This should also include a focus on ability self-administer and refill medications, taking into account individual and local situations and contexts, including, for example, the geo-political situation of the Middle East. Nurse can use study findings to inform development and implementation of nurse-led interventions to enhance cardio-protective medication adherence in Australia and Iraq, with clinical and cost-effectiveness outcomes informing clinical practice. Such interventions should address the principal behavioural causes of sub-

optimal adherence especially patients' belief about medication and their ability to correctly self-administer and refill medications. They should enable nurses to strengthen patients' knowledge and beliefs through motivational consultations, education and information sessions. Future research is recommended to explore predictors of medication adherence in greater depth and in broader CVD populations in both Australia and Iraq. Nurse-led interventions developed to apply study findings should be the subject of future trials in Australia and Iraq. The information provided by this study can support development of behaviour change interventions delivered by nurses across a wide range of cultures and settings and time points in the CVD journey.

**Acknowledgments**

The authors declare that there are no conflicts of interest that are directly relevant to the content of this review. This research was enabled by a doctoral scholarship for the first author from the Iraqi Cultural Attaché/ Canberra, Australia. The Authors would like to thank Jennifer Fields, CNC and Lesley Whitten, Clinical Pharmacist, for their contributions to the data collection.

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