Saudi Pharmaceutical Journal (2016) **24**, 182–188

King Saud University

Saudi Pharmaceutical Journal

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ORIGINAL ARTICLE

Evaluation and implementation of behavioral and educational tools that improves the patients' intentional and unintentional non-adherence to cardiovascular medications in family medicine clinics

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Received 24 January 2015; accepted 27 February 2015
Available online 20 March 2015

KEYWORDS

Adherence;
Non-adherence;

Abstract *Objective:* There are limited number of studies describing the reasons and interventions of non-adherence to cardiovascular medications in United Arab Emirates (UAE). We aimed to implement and evaluate the behavioral and educational tools that indicate the reasons of

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Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.jsps.2015.02.022

Cardiovascular diseases;
Cardiovascular medications

non-adherence in patients with cardiovascular diseases and improve patient's adherence to their cardiovascular medications. *Methods:* In this prospective interventional study, we recruited patients (n = 300) with cardiovascular diseases from three family medicine clinics in Al Ain, UAE in 2010. We assessed patients' responses to a validated brief medication questionnaire (BMQ). *Results:* At the end of the study, we observed a significant improvement in adherence. When we compared pre- and post-interventions, the mean (± standard deviation, SD) score for non-adherence to current regimen were 4.1 ± 0.2 vs. 3.0 ± 0.3 (p = 0.034); indication of negative believes or motivational barriers scores was 1.8 ± 0.4 vs. 0.9 ± 0.1 (p = 0.027); the indication of recall barrier scores was 1.6 ± 0.1 vs. 0.8 ± 0.1 (p = 0.014); and the indication of access barrier scores was 1.6 ± 0.2 vs. 0.7 ± 0.2 (p = 0.019). Mean blood pressure, fasting blood glucose, glycosylated hemoglobin, low density lipoprotein and postprandial blood glucose decreased significantly (p < 0.01) post-intervention. *Conclusion:* We reported that implemented multifaceted tools targeting patients, provider and healthcare system have improved the adherence to cardiovascular medications. Our interventions managed to improve patients' clinical outcome *via* improving adherence to prescribed cardiovascular medications.

1. Introduction

"Cardiovascular disease (CVD)" is an umbrella term referring to any disease affecting the heart and blood vessels. These diseases include hypertension, heart failure, coronary heart diseases and stroke. CVDs remain paramount cause of mortality globally (World Health Organization, 2003). Several risk factors, including physiological, psychological, behavioral and social habits, are associated with CVDs. Hypertension remains the major risk factor associated with a progressive rise of blood pressure, myocardial infarction (MI), heart failure, chronic kidney disease, cognitive decline and premature death. Hence, the cardiovascular drugs are currently the most used group of drugs in the geriatric populations.

A major challenge in treating CVD is patients' lack of understanding of their health condition and adherence to the treatment. Besides, patients are resistant to modify their lifestyle and pharmacological regime that further leads to the development of vascular diseases, (Al-Qasem et al., 2011). Therefore, adherence describes all behaviors influencing patients' outcomes, such as medication-taking behavior, following dietary and lifestyle advice, vaccinations and obeying follow-up visits (LaFleur and Oderda, 2004; Osterberg and Blaschke, 2005; Munger et al., 2007; Corrao et al., 2008; Thom et al., 2006). The additional term persistence is applied to describe the duration of time from initiation to discontinuation of drug therapy. Adherence and persistence are classified as two dimensions of medication-taking behavior.

Non-adherence can indicate a variety of conditions, such as not following the prescribed medical plan in general or can be related to non-adherence with medications, diet, medical appointments or refusal to stop a dangerous habit (smoking, illicit drug or alcohol use). WHO stated that treatment non-adherence is as a major public health problem that may result in disease persistence (Rasmussen et al., 2007). A report by WHO estimated that average rate of adherence to medication is around 50% among patients suffering from chronic diseases in developed countries and it is assumed to be lower in developing countries (World Health Organization, 2003). A recent review confirmed the existence of non-adherence to medication as a serious problem among patients with chronic diseases in the Middle East (Jackevicius et al., 2002). However, reported rates of non-adherence varied greatly, probably due to differences in definitions, measuring tools, study population, study design and predictors of adherence/non-adherence. Some barriers and predictors of non-adherence among patients in Middle East region were identified. However, the 19 studies included in this review did not provide consequential conclusions regarding the level of adherence (Jackevicius et al., 2002). Hence, there is need for further research on the prevalence of non-adherence and barriers to medication adherence in order to identify type of interventions needed to improve treatment adherence, particularly in patients with complex chronic diseases.

On average, approximately half of patients do not adhere to prescribed treatment regimens (Beardon et al., 1993). Studies have shown that poor adherence to beta-blockers or statin in post-MI patients can lead to an increased risk of morbidity and mortality (Kirking et al., 1995; Fincham and Wertheimer, 1988). After MI, several strategies including early follow up and sending printed reminders to patients were proposed to improve adherence (Jackevicius et al., 2002). Studies on non-adherence found that 1–21% of prescriptions were unfilled or not claimed from hospital pharmacies (Craghead and Wartski, 1991; Skutnik and Katsanis, 1997). In other studies, non-adherence to medications has been shown to increase mortality and hospitalizations (Jackevicius et al., 2007; Jackevicius et al., 2008).

The issue of adherence to cardiovascular medications is unique as most patients with CVDs were concomitantly having co-morbid conditions with evident poly-pharmacy. The problem of non-adherence to cardiovascular medications is of particular interest as it has direct impact on the disease management, prognosis and patient's quality of life. Medication adherence is not part of the electronic system neither incorporated in daily routine care in the United Arab Emirates (UAE).

To our knowledge, there is no any study which may provide insights on the adherence to cardiovascular medications in UAE. In the absence of relevant literature in our region, we aimed to conduct a study on the adherence of patients to

Table 1 Patient profile (survey respondents') with and without adherence to cardiovascular medications.

Parameter	*F, †(%)	Adherence		*P* value
		Good score	Poor score	
Age groups, [mean age 53 ± 2.1(years)]				
20 – 49	142 (47.3)	93 || (65.5)	49 (34.5)	
50 – 79	158 (52.7)	89 || (56.3)	69 (43.7)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**182 || (60.7)**	**118 (39.3)**	‡0.002
Gender				
Male [mean age 51 ± 1.6 (years)]	146 (48.7)	91 || (62.3)	55 (37.7)	
Female [mean age 49 ± 1.7(years)]	154 (51.3)	101 || (65.6)	53 (34.4)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	§0.057
Education				
School education	161 (53.7)	91|| (56.5)	70 (43.5)	
University and post university	139 (46.3)	101 || (72.7)	38 (27.3)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	‡0.037
Marital status				
Married	266*(88.7)	163 || (61.3)	103 (38.7)	
Single	34 (11.3)	29 || (70.6)	5 (29.4)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	‡0.002
BMI (kg/m^2)				
Normal weight ⩽ 25	62 (20.6)	43 || (69.4)	19 (30.6)	
Over weight > 25 to < 30	170 (56.7)	103 || (60.6)	67 (39.4)	
Obese > 30	68 (22.7)	46 || (67.6)	22 (32.4)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	‡0.001
Disease type [duration of disease in years (7 ± 3.1)]				
Diabetes	58 (19.3)	37 || (63.8)	21 (36.2)	
†Hypertension, diabetes, and CVD	71 (23.7)	43 || (60.6)	28 (39.4)	
Hypertension	78 (26.0)	47 || (60.2)	31 (39.8)	
Hypertension and diabetes	93 (31.0)	65 || (69.9)	28 (30.1)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	‡0.007
Monthly income				
< 2900 US $ (< 10, 000 Dirham)	53 (17.6)	20 (37.7)	33 || (62.3)	
2900–6000 US $ (10, 000 – 22,000 Dirham)	119(39.7)	85 || (71.4)	34 (28.6)	
6000 US $ (> 22, 000 Dirham)	128*(42.7)	87 ||(67.9)	41 (32.1)	
Subtotal (at each parameter subrows)	**300 (100.0)**	**192 || (64.0)**	**108 (36.0)**	‡0.012

Key:
* *F* = Frequency.
† (%) = percentage.
‡ $p < 0.05$.
§ $p > 0.05$, \|\| the highest percentage achieved in subrows, items within each scale were averaged after scoring.

cardiovascular medications and to intervene to the adherence of patients by improving patients' negative beliefs, motivational barriers, indication of recall barrier and indication of access barrier to adherence and the pattern of sustained improvement throughout the study period. Furthermore, we aimed to implement behavioral and educational tools that improve patient's adherence to their cardiovascular medications.

2. Methods

2.1. Ethics

The Al-Ain Medical District Human Research Ethics Committee (AMDHREC) has approved the study protocol. All subjects read the study information sheet and signed the informed consent prior to participation.

2.2. Study design

The cross-sectional study was performed in three main Family Medicine Clinics (FMCs) in downtown in 2010. These FMCs were specialized on chronic diseases such as CVDs and diabetes. Patients were randomly selected from clinic chronic disease database, whereby; legible candidates were invited to join the study. The FMCs have standardized registry for patients with chronic diseases. We used this registry to select patients with CVDs, diabetes and poly-pharmacy. Patients of both genders with UAE nationality, over 20 years of age, with CVD diagnosis over 3 months, taking 4 or more medications for CVDs (4 corresponds to the mean number of prescribed drugs in cardiology and medical clinic in Al Ain hospital, Al Ain-UAE) were included in the study (Elnour et al., 2008; Andrew et al., 2003). Pregnant women, patients with debilitating diseases were excluded from the study.

Table 2 Brief Medication Questionnaire (BMQ) scale scores.

Assessment interval → Scale parameter	Question as per BMQ Appendix A	Total score of items	Mean score baseline	Mean score at 3 months	Mean score at 6 months	Mean score at 9 months	Mean score at 12 months	*p* value (Post hoc)
A. Indication of non-adherence with current drug regimen	Questions 1a to 1e	5	4.1 ± 0.2	3.9 ± 0.2	3.6 ± 0.3	3.1 ± 0.4	3.0 ± 0.3	0.034
†**B.** Indication of negative beliefs or motivational barriers	Questions 1 g, and 2a	2	1.8 ± 0.4	1.7 ± 0.5	1.4 ± 0.2	1.2 ± 0.4	0.9 ± 0.1	0.027
C. Indication of recall barrier	Questions 1c and 3b	2	1.6 ± 0.1	1.6 ± 0.1	1.4 ± 0.2	1.0 ± 0.3	0.8 ± 0.1	0.014
D. Indication of access barrier	Questions 3c and 3e	2	1.6 ± 0.2	1.5 ± 0.1	1.2 ± 0.2	0.8 ± 0.3	0.7 ± 0.2	0.019

Key: The values of *p* compared baseline data with post-interventions data (at 3, 6, 9 and 12 months); †**B** = regarding efficacy, bothersome side effects, other concerns regarding a given drug and its effects. **C.** Indication of recall barrier = about potential difficulties remembering. **D.** Indication of access barrier = 1. Report any difficulty paying for medications 2. Report any difficulty getting refills in time.

Patients visiting the FMCs have regular monthly follow-up for the chronic diseases management strategy. We stratified patients considering the duration of drug treatment and number of years since diagnosis of CVDs. We utilized a calculation method to draw a reasonable sample for our population. We used 90% confidence level (90% actual mean falls within our confidence interval), 0.5 standard deviation (expected variance), and a margin of error (confidence interval) of ±5% (higher or lower than population mean our sample mean may fall). 90% – Z Score = 1.645; $(1.645)^2 \times 0.5(0.5)/(0.05)^2$, $(2.7 \times 0.25)/0.0025 = 270$. The needed sample size was estimated to be 270; however, we have increased this to 300 patients to allow for any dropouts. Therefore, we have recruited patients with CVDs ($n = 300$) from three FMCs in Al Ain city, UAE. These patients were prospectively followed for one year and data were reported for every patient at 3, 6, 9 and 12 months.

Patients' responses were assessed with a validated brief medication questionnaire (BMQ). Additionally, fasting blood glucose (FBG), postprandial blood glucose (PPBG), glycosylated hemoglobin (HbA1c), low density lipoprotein (LDL) and blood pressure (BP) were measured before and after the interventions. Baseline qualitative and quantitative data were collected for each patient from their medical files and *via* the questionnaires. Baseline assessment involved evaluation of each patient's BMQ. The baseline characteristics of the study population involved the identification and numbering of prescribed cardiovascular drugs. Patients were taking multiple numbers and doses of cardiovascular drugs for years. They did not receive any form of medication adherence advice, nor were examined for non-adherence.

2.3. The educational and behavioral interventions

The conceptual frame work of the interventions was extrapolated from the theory of planned behavior (TPB) with more integration of health belief model. The educational and behavioral tools have targeted patient's (health literacy, education, complexity of medications and socioeconomic status), health professional's (communication skills and behavioral support) and the healthcare system (practice environment, pharmacy ordering and refill system, access, educational materials and electronic health record). The interventions plan (clinical guidelines, information system, and team work) was introduced in one month after baseline (interventions), and thereafter reinforced once every three months for one year (Appendix A).

2.4. Brief medication questionnaire (BMQ) validity

The BMQ is a self-reporting tool used to identify patients at risk of non-adherence. In our study we used validated BMQ tool to assess adherence to cardiovascular medications, (Cherry et al., 2008). The tool includes a "5-Item Regimen Screen" (Appendix B) that asks patients how they took each medication in the past week, a "2-Item Belief Screen" that asks about drug effects and bother some features, and a "2-item Recall Screen" about potential remembering difficulties. Validity of the BMQ has been previously tested (Svarstad et al., 1999). The adherence risk score (ARS) measures the number of present adherence risk factors and is constructed by adding the subtotals listed above (Subtotal A + Subtotal B + Subtotal C + Subtotal D = ARS) (Cherry et al., 2008). The ARS ranges from 0 to 4, with "0" indicating non-self-reported non-adherence or barriers to adherence and "4" indicating presence of self-reported non-adherence and three types of barriers (Belief or Motivational barrier, Recall barrier, and Access barrier). The original English version of BMQ was translated into Arabic language, piloted and tested for psychometric component and the Cronback Alpha was found to be 0.73. An official written permission for using the BMQ was obtained from the original BMQ authors (Svarstad et al., 1999).

2.5. Outcome measures

The primary outcome was the improvement in responses to BMQ scores (at 3, 6, 9 and 12 months after the interventions). The secondary outcomes were disease-related as fasting blood glucose (FBG), postprandial blood glucose (PPBG), glycated

Table 3 Medications and clinical parameters.

Parameter	*F, †(%)	Adherence		*P* Value
		Good (score)	Poor (score)	
Drug classes		*F, †(%)	*F, †(%)	
Cardiovascular medications	**300 (100.0)**	233|| (77.7)	67 (22.3)	‡0.003
Antidiabetic medications	58 (19.3)	37|| (63.8)	21 (36.2)	‡0.049
Statins	213	110|| (51.6)	103 (48.4)	‡0.032
Fasting Blood Glucose Mean ± SD [Baseline 10.6 μmol/L to 8.0 μmol/L at 12 months]	**300 (100.0)**	178|| (59.3)	122 (40.7)	‡0.01
Post-prandial blood glucose Mean ± SD [Baseline 11.4 ± 0.6 μmol/L to 8.6 ± 0.5 μmol/L at 12 months]	**300 (100.0)**	183|| (61.0)	117 (39.0)	‡0.006
Glycosylated hemoglobin Mean ± SD [Baseline 8.9 ± 0.3% to 7.4 ± 0.4% at 12 months]	**300 (100.0)**	194|| (64.7)	106 (35.3)	‡0.02
Low Density Lipoprotein Mean ± SD [Baseline 3.1 ± 0.04 μmol/L to 2.7 ± 0.01; at 12 months]	**300 (100.0)**	169|| (56.3)	131 (43.7)	‡0.002
Systolic BP (mmHg) Mean ± SD [Baseline 143.0 ± 15.0 mmHg to 132 ± 10.7 mmHg at 12 months]	**300 (100.0)**	216|| (72.0)	84 (28.0)	‡0.027
Diastolic BP (mmHg) Mean ± SD [Baseline 97.0 ± 12.0 mmHg to 83 ± 8.7 mmHg at 12 months]	**300 (100.0)**	207|| (69.0)	93 (31.0)	‡0.023

Target blood pressure = < 130/80 mmHg for people with diabetes.
§ $p > 0.05$, ||the highest percentage achieved in subrows, items within each scale were averaged after scoring.
Key:
* F = Frequency.
† (%) = percentage.
‡ $p < 0.05$.

hemoglobin (HbA1c), low density lipoprotein-cholesterol (LDL-C) and blood pressure (BP).

2.6. Data analysis

Data analysis was carried out using the Statistical Package for Social Sciences, version 20 (SPSS Inc., Cary, NC, USA). Data were presented as proportions, means with standard deviations (±SDs) when appropriate. Differences in categorical variables within respective comparison age and gender groups and poor vs. good adherence were analyzed using chi-squared test. The continuous variables (FBG, PPBG, HbA1c, LDL-C and BP) were analyzed using one way analysis of variance. The BMQ scores at the different assessment intervals were analyzed by using chi-squared test. We performed regression analysis (significance was by *F*-test, followed by *t*-tests of individual important parameters) to identify the variable relationship (adherence ARS) with non-adherence to cardiovascular medications. *P* values <0.05 were considered significant.

3. Results

We did not experience any dropouts through the study. The demographic and anthropometric characteristics of the participants were shown in Table 1. The mean age was 53 ± 2.1 years. For the subjects with or without multiple cardiovascular risk factors adequate adherence was found to be 69.9% and 30.1%, respectively. The correlation between adherence and patient's income was statistically significant among intermediate and high income patients. However, no such relation was documented in low income patients (Table 1).

3.1. Indication of non-adherence with current drug regimen

3.1.1. Brief medication questionnaire (BMQ)

BMQ scale mean scores (±SD) at baseline (total scores = 5.0) have revealed positive indication of non-adherence with cardiovascular medications as indicated by mean score of 4.1 ± 0.2. The reasons for this nonadherence were as follows (in descending order): missed dose/doses, missed day(s), patient failed to mention or list their prescribed drug(s) and patient stopped or interrupted treatment for different reasons (Table 2). The adherence risk score (ARS) yielded an estimate of 3.1 ± 0.2 for the number of adherence risk factors present which indicated the presence of self-reported non-adherence and three types of barriers (Belief or Motivational barrier, Recall barrier, and Access barrier). However, after interventions the ARS mean scores improved over time for the different assessment periods: 2.9 ± 0.1, 2.4 ± 0.1, 1.8 ± 0.1 and 1.4 ± 0.2 at 3, 6, 9, and 12 months; respectively. The screen of indication of negative beliefs or motivational barriers to adherence was represented by efficacy, bothersome side effects, other concerns regarding a given drug and its effects (total scores = 2.0) and was reported at baseline with mean scores (1.8 ± 0.4), (Table 2). The indication of "Recall barrier" was addressed using two questions: whether patient received multiple doses regimen (2 or more times/day) and/or reports any difficulty remembering his/her medications. Indication of "Recall barrier" (total scores = 2.0) was reported at baseline with mean scores (1.6 ± 0.1), which have indicated the presence of Recall barriers (Table 2).

In order to address "Access barrier", we have used two questions:1. Report any difficulty paying for medications 2. Report any difficulty getting refills in time. Indication of Access barrier (total scores = 2.0) was reported at baseline

with mean scores (1.6 ± 0.2). The results indicated the presence of Access barriers (difficulty paying for medications) as hindrance to adherence to cardiovascular medications (Table 2). After interventions, the mean scores on this domain improved over time for the different assessment periods: 1.5 ± 0.1, 1.2 ± 0.2, 0.8 ± 0.3 and 0.7 ± 0.2 at 3, 6, 9 and 12 months, respectively (Table 3).

4. Discussion

Cardiovascular diseases and hypertension are associated with enormous economic and personal burden through increased risk of stroke and kidney disease (Cherry et al., 2008; James et al., 2014; Go et al., 2013). The treatment of CVDs has been unequivocally shown to positively impact patient-related outcomes leading to reductions in stroke and heart failure (Chobanian et al., 2003).

In the current study, the predicting and estimated risk factors for non-adherence to prescribed cardiovascular medications were identified. Considering gender, our results indicated that males were less compliant with cardiovascular medications than females (Wang et al., 2005).Besides, education and high income also provide good adherence to drug regimens.

In patients who are treated with cardiovascular drug regimens, we have identified contributory factors to non-adherence as missed treatment doses or day(s), failure to report non-adherence, or interrupted treatment regimens. Besides, we have found 40% more adherence in patients over 65 years as compared to those under 65 years, which was in contrast to the study by Monane et al., (1996).

Healthcare professionals have to shorten regimens where possible (Murphy et al., 2003; Black, 1999). Besides, they must educate their patients about the significance of adhering to their prescribed regimens. In accordance with currently available evidence, our findings highlighted that some patients lack medication knowledge and this is the major cause for poor adherence (Mini et al., 2012). In general, poly-pharmacy has major impact on adherence to cardiovascular medications (Stone et al., 2001; Golin et al., 2002) and the most frequent reason for non-adherence was multiple medications (poly-pharmacy) herein. Our current interventions succeeded in weaning patients' negative beliefs, improving motivational barriers, indication of recall barrier and indication of access barrier to adherence and the improvement was sustained throughout the study period.

A retrospective study reported that compared to concurrent two-pill therapy single-pill combination therapy (contained in one pill dosage form) provided 20% higher adherence and more subjects from the single-pill combination therapy continued to take prescribed medication for 12 months (Dezii, 2000; Haynes et al., 2008). In an electronic monitoring study conducted on 149 patients receiving cardiovascular medications, only dosing frequency ($p = 0.0001$) but not drug class ($P = 0.71$) was associated with medication adherence in the adjusted analysis. The authors have suggested that providers may consider using once daily formulations to optimize adherence and should assess adherence among all treated patients with uncontrolled hypertension (Moise et al., 2014). Thus, a plausible strategy to improve adherence to medications may include considering a combination single-pill therapy where applicable. In another study conducted by Castellano et al. (2014), the researchers suggested that use of a poly-pill strategy met the primary end point for adherence for secondary prevention following an acute MI (Castellano et al., 2014a). This was also evident for present study patients with poly-pharmacy and multiple adherence risk factors. Major trials are being conducted and they will hopefully provide definitive evidence on the efficacy of the poly-pill in reducing cardiovascular events in a cost-effective manner. The results of these trials will determine whether a poly-pill strategy can suppress the CVD pandemic and will potentially provide the evidence to implement in cost-effective, easy, simple, and innovative solution for the global burden of CVDs (Castellano et al., 2014).

Another interesting finding in our study was a remarkable decrease in mean values of FBG, PPBG, HbA1c, LDL and BP, which may be attributable to the interventions and the strict follow up of patient's adherence issues throughout the study period. Therefore, patients with CVDs should also be informed particularly by their pharmacists that adherence can improve specific blood markers for both for CVDs and diabetes.

The use of multifaceted approach comprising of educational and behavioral tools to improve adherence to cardiovascular medications was applied in the present study. Another important point is that the prospective follow up of patients and enforcement of successive structured interventions were succeeded in patients who were not adhering to cardiovascular medications. Besides, subsequent respective measures were deployed. However, our sample population may not be representative of general practitioner clinics and rather more like the specialized clinics as it is drawn from FMC targeting only patients with CVDs.

In conclusion, the study outcomes have direct influence on health policy, medication safety practices and clinical outcomes of patients with CVDs. The behavioral and educational interventions deployed in this study can be friendly used by healthcare providers in UAE and in similar settings for further improving adherence to cardiovascular medications. Similar studies with higher number of randomized subjects are needed to improve patient adherence in Middle East, particularly in UAE.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jsps.2015.02.022.

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