

## Other Papers

Polish Psychological Bulletin  
2017, vol. 48(3) 380–387  
DOI - 10.1515/ppb-2017-0044

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### Adherence to treatment among chronically ill ambulatory patients

**Abstract:** According to Information-Motivation-Behavioural Skills model (IMB), accurate Information, strong Motivation and adequate Behavioural skills are prerequisites of treatment adherence. This model has been verified among chronically ill patients, usually suffering from one particular disorder. No studies report how the model fits data from a more diverse group. The aim of the study was to analyze adherence and its barriers in a group of three hundred patients suffering from various, common chronic disorders. They filled out IMB and Adherence Questionnaire. Information and Motivation correlated moderately (.35). Behavioural Skills was the strongest predictor of adherence (.24). An additional relationship was found: Information and Motivation interacted and the role of either of these dimensions vanished if the indices of the other were high enough. The relationships between IMB dimensions and adherence were confirmed in a varied clinical sample. Behavioural skills must be considered when working with non-adherent patients, as they are the strongest predictor of adherence. Other interventions may be limited to either Information or Motivation only if there is a chance of raising one of them to extreme levels. This may be useful with special cases, when increasing both is problematic.

**Key words:** adherence, chronic illness, Information-Motivation-Behavioural Skills model, treatment

#### Introduction

Inconsistent or poor adherence to treatment is a worldwide problem (WHO, 2003). Therefore, there is a strong need to study the mechanisms underlying adherence, because its low levels may impact patients' health, life-expectancy or diminish the quality of their lives (Haynes, 2001 in: WHO, 2003). This seems important both in acute and chronic conditions. In all cases, it may be important to identify the level of non-adherence and take it into consideration while planning healthcare.

Despite a growing number of studies on non-adherence, there is a dearth of knowledge relating to the mechanisms governing adherence behaviour. Classical models of behaviour also aim to explain the underlying mechanisms of adherence (e.g. the Health Belief Model by Rosenstock, Strecher & Becker 1988; the Social-Cognitive Theory by Bandura, 1986; or the Theory of Reasoned Action by Ajzen & Fishbein, 1980), while newer studies aim to re-define

what adherence is (Vrijens et al., 2012) or list its predictors (e.g. Quine, Steadman, Thompson, & Rutter, 2012). One of the more recent and promising theories undergoing verification in various samples is the Information Motivation Behavioural Skills model. We chose this model mostly because it treats adherence as a very specific type of behaviour and aims to explain the relationships between adherence behaviour and perceived barriers.

The Information Motivation Behavioural skills model (IMB) was developed in reference to AIDS prevention (Fisher, Fisher, Williams, & Malloy, 1994; Fisher, Fisher, Bryan, & Misovich, 2002) and adherence to antiretroviral therapy among persons infected with HIV (Fisher, Fisher, Amico, & Harman, 2006; see also: Kiene, Fisher, Shuper, Cornman, Christie, MacDonald, & Fisher, 2013). Recent studies, however, indicate, that the model can also be used across a variety of clinical groups of chronically ill patients e.g. among patients with type 2 diabetes (Junling, Jingli, Yaocheng, & Jinming, 2013), patients undergoing

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long-term treatments (e.g. after coronary bypass: Zarani, Besharat, Sarami, & Sadeghian, 2012) and in the context of health promotion (e.g. sweetened beverage consumption: Goodell, Pierce, Amico, & Ferris, 2012; or breast self-examination: Misovich, Martinez, Fisher, Bryan, & Catapano, 2003). If the model is to be effectively used to explain non-adherence and design effective interventions, there is a need to verify it in more heterogeneous groups of patients and in the context of various healthcare systems.

### **The Information Motivation Behavioural Skills Model**

The IMB Model focuses on three aspects: Information, Motivation and Behavioural Skills, their mutual relationships and relationships between these dimensions and adherence behaviour. It combines approaches from social and health psychology and provides a theoretical framework for analyses of adherence behaviours, health promotion and intervention planning (Fisher, Fisher, Amico, & Harman, 2006).

In the most general sense, the IMB model states that Information, Motivation and Behavioural Skills determine health-related behaviour. For instance, to adhere to a proposed therapy, the patient needs sufficient information on the illness and treatment, be motivated to stay healthy and take medication according to plan, and plan and carry out his or her behaviour in an effective way. The Information dimension refers in part to the illness itself, because the patient needs to understand its basic mechanisms and threats, but it mostly refers to the treatment regimen – how and when to take medication, understand possible side effects and factors limiting medication effectiveness (such as consequences of combining medication with other substances). The Motivation dimension is expressed in individual motivation to adhere to the proposed therapy, based on personal and social motivation, and also on the belief that the treatment is the best way of maintaining good health or managing the illness. The model also includes aspects of social motivation, stimulated by perceived support from significant others. If there are deficits in motivation, then the chances of good adherence are limited, because the motivation to adhere to treatment will not govern behaviour and other goals may take precedence. The Behavioural Skills dimension is a ‘critical prerequisite of adherence and determine[s] whether even well-informed and motivated individuals will be capable of adhering’ (Fisher, Fisher, Amico, & Harman, 2006, p. 464). These Behavioural Skills may include specific strategies, such as storing medicine in more than one place (at work, at home, in the purse), planning for unexpected circumstances, planning doctor appointments in a way that makes it possible to refill prescription drugs on time. The model states that Information and Motivation work mainly through behavioural skills to perpetuate adherence. These two dimensions may directly influence adherence but on their own, without adequate behavioural skills they may not be sufficient, (e.g. it is not enough to have information on the treatment if the patient is unable to use it). The assumption in the model was that behavioural skills are

particularly important with novel or complex treatment plan. Therefore, it is possible that with other, simpler medication regimens the relationships between these dimensions may be somewhat different. A number of studies conducted among patients suffering from various disorders suggested that this may be true. Even though most research on IMB model is devoted to persons infected with HIV and to AIDS prevention (the context for which the IMB model was originally developed), there is sufficient rationale and data to believe, that these three factors, I-M-B, are important in determining adherence in chronic illnesses (e.g. in diabetes: Mayberry & Osborn, 2014), not only in complex antiretroviral therapy. The assumption in this study is that these three dimensions are important for any adherence behaviour in most chronic illnesses, varying in terms of their seriousness or complexity of treatment plan. In this study, patients suffering from various chronic illnesses reported on their IMB dimensions and adherence behaviour. The patients suffered from milder conditions (e.g. hay fever) to more serious illnesses (e.g. Multiple Sclerosis) and their treatment plans ranged from very simple (taking one pill a day) to complex (combining pills, injections and control).

### **Recent IMB model verifications**

Apart from the original verifications conducted among persons infected with HIV, the model was also verified in other clinical samples (e.g. in diabetes: Mayberry & Osborn, 2014) and in different cultural contexts (Iran: Zarani, Besharat, Sarami, & Sadeghian, 2012, China: Junling, Jingli, Yaocheng, & Jinming, 2013, USA: Mayberry & Osborn, 2014). Other studies report on interventions based on the model (e.g. in CABG patients: Zarani, Besharat, Sarami, & Sadeghian, 2012). Research on IMB model also varies in terms of methodology – some researchers measure IMB dimensions directly (Goodell, Pierce, Amico, & Ferris, 2012; Zhu, Cai, Ma, Li, Zhu, He, & Qiao, 2013), while others rely on indirect measures, such as provider-patient communication, social support and self-efficacy (Junling, Jingli, Yaocheng, & Jinming, 2013), knowledge, fatalism, social support and self-care (Osborn & Egede, 2010).

Even though the number of studies using the IMB model has increased in the recent years, there is still a dearth of studies verifying its assumptions in various clinical groups and cultural settings. Most studies that do verify the model’s fit report on data from patients infected with HIV or, to a smaller degree, on data from patients suffering from one type of chronic illness. There is little to no data from more diverse clinical samples and no reports based on the IMB from Eastern Europe (and little data on adherence in general from this area). Data from a more diverse group of patients (in terms of their health issues) may provide stronger arguments for the model’s universality, mainly since existing research varies in terms of methodology, making comparisons difficult or impossible. Also, the characteristics of healthcare systems in different countries may impact all aspects of patient adherence, including the IMB dimensions. A healthcare system characterised by understaffed and underpaid

health facilities, and a poor ratio of nurses to doctors (e.g. least doctors per capita in EU is in Poland; low pay in post-communist countries; OECD, 2013) may lead to poor adherence through all three IMB dimensions. For example, there may be a poor level of Information if the doctors have little time to successfully inform their patients; poor Motivation, if patients need to wait long for doctor appointments; or patients may lack necessary Behavioural Skills if there is insufficient medical staff to help train them. With these systemic issues, the relationships between the IMB dimensions may differ from those found in other cultural settings, because the mechanisms governing them may be different. For example, patients may seek information on their own and not get it from reliable sources. This may impact adherence and account for the difference observed between different settings.

## Method

### Participants

$N=300$  patients suffering from chronic illness or being treated with long-term therapy participated in the study. We recruited the patients in clinics, usually when the patients were waiting for their doctors' appointments (except for the post-transplant group, contacted by traditional mail). The inclusion criteria were wide – the patients were informed about the purpose of the study and asked whether they were suffering from a chronic illness that required systematic pill-taking. Originally  $N=315$  patients filled out the forms but 15 cases were removed due to missing data. All participants were outpatients, living at home and administering their treatments themselves or with the help of family. They represented various clinical groups and their distributions are presented in Table 1. Most of the patients were women (56%). Participants were aged from

18 to 90 ( $M=51$ ,  $SD=17$ ,  $Me=52$ ). 8% received primary education, 54% had high school or vocational education 38% had higher education.

### Measures

#### Information-Motivation-Behavioural Skills

The IMB questionnaire (in press) is based on the Information-Motivation-Behavioural Skills model of adherence and it contains 22 items reflecting the three dimensions: eight items refer to Information, eight to Motivation and six to Behavioural Skills. The Information items were designed to measure the extent to which participants feel informed about their treatment (e.g. I know the possible side effects of my medication). The motivation aspect reflects the level of motivation to adhere to treatment and the belief that the treatment is the correct way to manage the disease (e.g. I believe that I will live longer if I take my medication). The behavioural skills aspect reflects the extent, to which patients feel confident about abilities that can influence adherence (e.g. I am able to plan my day in such a way, that I can take my medication on time).

The participants answer on a scale from 1-completely disagree to 5-completely agree and high scores reflect a high level of Information, Motivation and Behavioural skills (final scores can range from 1 to 5). All subscales reached sufficient reliabilities (see Table 2. for Cronbach's alphas).

#### Medication adherence

Medication adherence questionnaire (under review) consists of eight items: four refer to adherence to medical treatment and four refer to adhering to lifestyle changes suggested by the doctor. Since initial analyses indicated that these two dimensions are separate and their relationships with IMB dimensions are different we chose to focus on

**Table 1. Groups of participants**

Group	Description	<i>n</i>	%
Cardiovascular	Patients with cardiovascular disorders, e.g. hypertension, atherosclerosis, chronic venous insufficiency	79	27
Diabetic	Diabetic patients	24	8
Cardiovascular & Diabetic	Diabetic patients with at least one cardiovascular disorder	23	8
Thyroid	Patients with thyroid disorders, hyperthyroidism or hypothyroidism	26	9
Psychiatric or Neurological	Patients suffering from disorders that may impair cognitive or emotional functioning (e.g. depression, SM, anxiety)	16	5
Pain or Discomfort	Patients with disorders that mainly cause pain or discomfort (e.g. osteoarthritis, rheumatic disorders, irritable bowel syndrome, ulcers)	17	6
Asthmatic or Allergic	Patients with asthma or allergies	19	6
Post-transplant	Patients who received kidney transplant	75	25
Other	Other patients with disorders not fitting any of the above categories (e.g. dermatitis, neoplasm)	19	6

*Note.* Comparisons of these clinical groups in terms of adherence levels are discussed in another publication by the author of this paper and colleagues, in preparation.

**Table 2. Means, standard deviations, internal consistencies and intercorrelations (above axis) and dependent t-test scores (below axis) between Information-Motivation-Behavioural skills and Adherence to treatment - outpatient varied clinical group (N = 300)**

		Descriptive statistics			Intercorrelations/dependent t-test			
		<i>M</i>	<i>SD</i>	<i>α</i>	<i>I</i>	<i>M</i>	<i>B</i>	<i>A</i>
Information	I	4.55	.49	.74	-	.35***	.48***	.34***
Motivation	M	3.69	.84	.77	17.77***	-	.33***	.39***
Behavioural Skills	B	4.12	.74	.72	10.88***	7.79***	-	.48***
Adherence	A	4.57	.52	.66	.52	18.41***	11.41***	-

I – Information, M – Motivation, B – Behavioural Skills, A – Adherence

^p = .05; \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

the medical adherence aspect. In consequence, we use four items from the original eight and they reflect the extent to which the patients adhere to their medicine regimen (e.g. I take all my pills). The answers are given on a scale from 1-never to 5-always and high values reflect good adherence. The scale reached sufficient reliability (see Table 2. for Cronbach's alpha).

### Procedures

Data from post-transplant patients were gathered by medical students, who sent questionnaire sets via traditional mail. Data from other patients were gathered by psychology students, who approached patients through clinics. The participants received questionnaires in envelopes to be sealed and returned after completion. We observed all local ethical standards. Patients provided informed consent, were informed that the study is voluntary and fully anonymous (for most of the sample excluding post-transplant patients) or coded to ensure anonymity (for post-transplant patients).

### Statistical analyses

First, we tested two hypotheses (1) that Information affects adherence through Behavioural skills and (2) that Motivation affects adherence through Behavioural skills. We used SPSS ver.22 (IBM Corp., 2013) with Andrew Hayes's Process tools (described in: Hayes, 2015), to analyze the significance of mediation (Process model 4).

Second, we tested the whole theoretical model of Information-Motivation-Behavioural Skills and Adherence behaviour. This was done using SPSS ver.22 (IBM Corp., 2013) with AMOS Graphics software, and a version of the model is presented in Figure 1. We entered Information, Motivation, Behavioural Skills and Adherence as latent variables (questionnaire items were entered as observed variables). We then used regression analysis to compute coefficients for paths between these four dimensions (Information Motivation, Behavioural Skills and Adherence) and to determine which dimensions significantly predict adherence.

Third, we conducted additional analyses to verify the effect of Information on adherence, because it had very high levels and the results of the first two analyses yielded inconsistent results. We used regression analysis

and entered Information, Motivation and Behavioural Skills in the first step and product of Information\*Motivation and Information\*Behavioural Skills in the second step. We then used Hayes's Process tools (2015) to analyze the interaction and Dawson's spreadsheet (Dawson, 2014) to plot this interaction on a graph.

## Results

### Descriptive statistics

Data presented in Table 2 indicates that there are moderate, positive correlations between all variables and that mean scores are high – the patients generally declared that they were well-informed, had good Behavioural Skills and adhered to their therapeutic plan but they had slightly lower scores on Motivation. All reliabilities reached acceptable levels.

### Mediation Assumptions of the IMB model

The IMB model suggests that Information and Motivation are interconnected and that they influence Adherence through Behavioural Skills. This study tested if the relationship between Information and Adherence Behaviour was mediated by Behavioural Skills and whether the relationship between Motivation and Adherence Behaviour was mediated by Behavioural Skills.

Firstly, two regression analyses showed that Information and Motivation both predicted Adherence Behaviour (direct effects) and bootstrapped confidence intervals indicated that the indirect effect of Information on Adherence Behaviour through Behavioural Skills was significant. The same was observed for the Motivation aspect. This means that Behavioural Skills is a mediator for Information and for Motivation.

We also used AMOS graphics to analyze the estimates for direct and indirect effects and assess if the mediation was partial or full. The relationship between Information and Adherence behaviour was fully mediated (Information became an insignificant predictor if Behavioural Skills were entered as a mediator variable), whereas the relationship between Motivation and Adherence Behaviour was partly mediated (the estimate dropped from .54,  $p < 0.001$  to .33;  $p < 0.001$ ).



**Table 3. Direct and indirect effects – regression analysis**

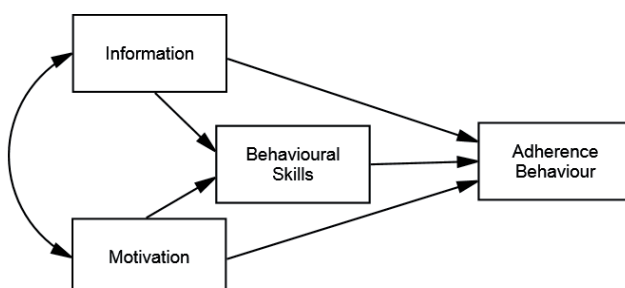
Mediation 1: Information → Behavioural Skills → Adherence behaviour						
	Estimate	SE	R <sup>2</sup>	Constant	LLCI	ULCI
Direct effect			.12	1.89		
Adherence ← Information	.37***	.06			.2516	.4893
Direct effect			.23	.80		
Behavioural Skills ← Information	.73***	.08			.0876	1.5196
Direct effects			.24	2.66		
Adherence behaviour ← Behavioural Skills	.29***	.04			.2032	.3693
Adherence behaviour ← Information	.16*	.06			.0360	.2877
Indirect Effect						
Adherence behaviour ← Behavioural Skills ← Information	.21*	.04			.1332	.2962
Mediation 2: Motivation → Behavioural Skills → Adherence behaviour						
	Estimate	SE	R <sup>2</sup>	Constant	LLCI	ULCI
Direct effect			.15	3.67		
Adherence ← Motivation	.24*	.03			.1752	.3117
Direct effect			.11	3.06		
Behavioural Skills ← Motivation	.29***	.05			.1898	.3869
Direct effects			.29	2.82		
Adherence behaviour ← Behavioural Skills	.28***	.04			.2028	.3523
Adherence behaviour ← Motivation	.16***	.03			.0972	.2297
Indirect Effect						
Adherence behaviour ← Behavioural Skills ← Motivation	.08*	.02			.0469	.1267

Note. \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ , \*  $p < 0.05$

### IMB model fit

We used AMOS graphics to test the whole model presented in Figure 1, and the model did not fit the data. Absolute model fit indicated that the model needed modification with  $\chi^2 = 625.745$ ,  $df = 293$ ,  $p < 0.001$ , RMSEA was calculated at .06 and GFI at .85, incremental model fit indices were all computed at levels between 0.8 and 0.9,

**Figure 1. Information - Motivation - Behavioural Skills Model and estimate values in the Polish sample of chronically ill patients**



so the model could not be accepted. Modifications did not result in sufficient fit.

Path coefficients (displayed in Figure 1) indicate that if all variables are introduced into the model, the effect of Information on Adherence behaviour becomes insignificant (congruently with full mediation). Comparison of effects indicates that Behavioural Skills are the strongest predictor of Adherence behaviour, followed by Motivation. These three variables explain 29% of the Adherence variance, whereas Motivation and Information explain 26% of Behavioural Skills variance.

### Development of the model – moderating effects

The significance of the Information dimension was different from that in the original model, so additionally interaction term of Information with the two remaining dimensions of the model were entered into regression. The assumption was that the effect of Information on Adherence Behaviour may be moderated by the level of Motivation or by the level of Behavioural Skills.

The product of Information\*Motivation and the product of Information\*Behavioural Skills (standardized) were

computed. Standardized values of Information, Motivation and Behavioural Skills were entered as the first step of the regression analysis, and product terms in the second step of the analysis. By using the enter method and entering Information, Motivation and Behavioural Skills it was possible to verify if entering interactions caused a significant increase in the explained variance of adherence.

**Table 4. Information, Motivation, Behavioural Skills and their interaction as predictors of Adherence Behaviour – regression analysis (Method = Enter)**

Predictor	Adherence Behaviour		
	$\Delta R^2$	Estimate	SE
Step 1.	.29***		
Information		.09	.06
Motivation		.35***	.04
Behavioural Skills		.24***	.04
Step 2.	.02*		
Information*Motivation		-.16**	.03
Information*Behavioural Skills		-.01	.02
Constant		2.885	
Total R <sup>2</sup>	.31		
N	282		

Note. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

The interaction between Information and Motivation was significant, so moderation was analyzed using Hayes's Process Tool (Model 2) and the effects of Information on Adherence Behaviour for different levels of Motivation were plotted. This helped estimate the effect of Information on Adherence behaviour at various levels of Motivation (and inversely: if Motivation effect is maintained at all levels of Information). The analysis (Table 5) indicated that when the Motivation dimension is at its highest, the effect

**Table 5. Conditional effect of independent variable for Adherence behaviour at values of the moderator**

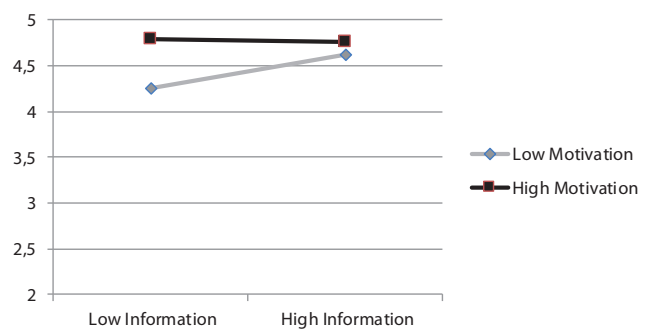
MOTIVATION level	Effect	SE	LLCI	ULCI
2.85	.37***	.07	.2321	.5139
3.69	.18**	.07	.0465	.3066
4.53	-.02	.11	-.2349	.1951
INFORMATION level				
4.06	.31***	.05	.2074	.4168
4.56	.19***	.04	.1274	.2670
5.00	.09	.05	-.0009	.1876

Note. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

of Information becomes insignificant— similarly when the Information is at its highest the Motivation effect becomes insignificant.

The interaction between Information and Motivation plotted using Dawson's computation techniques (Dawson, 2013) are displayed in Figure 2.

**Figure 2. The effects of Motivation x Information on Adherence to treatment**



## Discussion

The aim of the study was to analyze if the Information Motivation Behavioural Skills model of adherence to treatment can be adequate in a clinically diverse sample. Results confirmed the relationships between the elements of the model – Behavioural Skills mediated the relationship between Information and Adherence Behaviour (full mediation) and between Motivation and Adherence Behaviour (partial mediation). The entire model, however, did not fit the data so other possible relationships between the elements were investigated. Results showed a significant interaction between Information and Motivation. These two dimensions jointly influenced Adherence Behaviour and the conditional effects suggested that the effect of Motivation is lost with very high indices of Information and vice versa.

The IMB model was developed to explain adherence in AIDS prevention and later also to explain adherence to HAART among patients infected with HIV. Recent studies, however, indicate, that the model can also be used in other groups of chronically ill patients (Mayberry & Osborn, 2014), patients undergoing long-term treatments (Zarani, Besharat, Sarami, & Sadeghian, 2012) and in the context of health promotion (Goodell, Pierce, Amico, & Ferris, 2012; Misovich, Martinez, Fisher, Bryan, & Catapano, 2003). This study shows, that it can be successfully used in a variety of clinical groups, from milder ailments (such as hay allergies) to the more serious ones, and the relationships between the IMB dimensions are mostly maintained. However, the whole model in this study did not fit the data, so the underlying mechanisms may need to be investigated further. These findings indicate, that the relationships between IMB dimensions are adequate also for adherence investigations among patients suffering from disorders of varied severity and treatment plan.

Motivation and Information dimensions were only moderately correlated. This means that they are connected and may influence one another, but they are separate and therefore possibly depend on different factors. Motivation dimension may depend on the importance placed on health as a value. Studies show, that health is central in lay concepts of well-being second only to relationships with other people, and among people in their 40s it is the most important dimension (Bojanowska & Zalewska, 2015). In this context, it seems plausible that health is a generally universal value (most people want to be healthy), so the differences in the level of motivation may not only pertain to the will to be healthy, but also to the belief, that the proposed treatment is the correct way of doing that and that it is necessary. While both these interpretations were included in the IMB model, the latter issue may also be referred to the health belief model sub-dimension of perceived benefits (Rosenstock, Strecher, & Becker, 1988). If the patients do not believe that the treatment is necessary then they may not see the treatment as beneficial for their health, for example if they do not perceive their illness as severe or life-threatening. At this point, Information may become an important element in stimulating Motivation – informing the patient of the benefits of the treatment (or threats of non-adherence) may increase Motivation by increasing its perceived benefits. Possibly the correlation between Motivation and Information is only moderate because it is mediated by perceived benefits. On the other hand, the relationship between Motivation and Information can be reciprocal in that Motivation can encourage the patient to seek Information. This, however, may not always be beneficial, since the patient may seek information in unreliable sources, such as the Internet or other patients. In the present study, the Information indices were very high, and patients may be at risk if they report good knowledge of their health issues, while its quality is objectively poor. On the other hand, these high scores fit the assumptions seen in Morisky-Green questionnaire, where only the highest scores are interpreted as good adherence and even a small drop in scores is alarming (see computation and interpretation of adherence levels in: Morisky, Green, & Levine, 1986).

The mediatory role of Behavioural Skills was partly confirmed. Verifications of the IMB model have been conducted in the context of complex treatments, such as HAART. This type of therapy is complex so the correct Information and a high level Motivation is essential if the patient is to develop all Behavioural Skills needed to successfully manage the therapy. The present study showed, that these relationships are also found in other clinical groups, even if the therapeutic plan is much simpler and the treatment plan calls for more basic behavioural skills (e.g. skills that may prevent the patient from forgetting about their medication). Motivation is needed to govern behaviour and mobilize resources (also cognitive, essential in remembering to take pills on time), while any deficits in Information dimension may lead to the patient not knowing to which behaviours these resources should be devoted (e.g. what possible side effects to plan for and how). While

motivation can also directly influence adherence (partial mediation of behavioural skills), the role of Information is fully mediated. Possibly, information is used to develop specific skills that influence adherence, but in itself it does not do much to increase it – there may be no use for information if the patient does not know what to do with it. In terms of practice this may be a clear indication that this area must not be neglected – it can be stimulated either through information and motivation or directly through behavioural skills training. However, studies indicate that teaching behavioural skills may be problematic (Zarani, Besharat, Sarami, & Sadeghian, 2012). This in turn suggests that the role of medical assistants may need to be considered more, especially in healthcare systems where there is a poor ratio of nurses to doctors (see: OECD, 2013).

We found an interaction effect of Motivation and Information for Adherence. Conditional effects showed that with extremely high Motivation the Information aspect does not predict adherence (and inversely). This has a practical implication – in order to increase adherence it may be enough to work with only one, chosen dimension and not necessarily both. There is probably a certain, basic level of both of these dimensions that is necessary for adherence, but in some cases it may be easier to work with only one. However, if one aspect is ignored, the other must increase up to extreme values. On the other hand, there is no clear indication as to which of the two to choose in a particular case. Reaching good indices of one of these dimensions may not be possible for some patients, for example, patients with seriously limited cognitive abilities may not be able to reach very high indices on the Information dimension. In these cases it may be possible to reach good adherence through and increase in Motivation and good Behavioural Skills training.

#### Limitations and future research

Firstly, this study used two new methods – the IMB questionnaire and the adherence questionnaire. Even though they had a good factor structure and internal consistency, there were some doubts about the very high Information indices. These tools were developed to measure IMB dimensions across clinical groups and this may be a part of the problem – the items had to be general enough to be applicable to various illnesses and treatments. The sources of information were not investigated so its quality may have been poor. This needs to be taken into account. Secondly, the severity of the illness was not coded and it seems that for the motivation aspect this may be a crucial dimension.

These limitations also suggest some directions for future studies: severity of illness and sources of information may need to be investigated in reference to the model dimensions and the relationships reported here may need to be compared across various clinical groups. The studies conducted until now in various groups of patients used varied methodology so it is difficult to compare their results. Moreover, there is a dearth of studies on the IMB model that would simultaneously use direct and indirect methods, for example measure motivation for adherence

while at the same time measuring it indirectly through social support indices.

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