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USE OF CELL PHONE MESSAGES FOR SMOKING CESSATION: A SYSTEMATIC REVIEW[1]

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ABSTRACT. Innovative forms of communication technologies such as Internet and mobile phone are increasingly being used to provide information and support to smokers who want to quit. The objective of this study was to conduct a systematic review about the use of mobile text messaging as an intervention for people who want to quit smoking and the possible effects of this intervention on tobacco control. Searches were conducted on PubMed, PsycInfo, Scielo and Pepsic. Search terms included: ["tobacco use cessation" OR "tobacco use disorder"] AND ["interventions studies" OR "clinical trial" OR "evaluation studies"] AND ["text messaging"]. The selection criteria were: 1) addressing the subject of mobile text messages for smoking treatment; 2) being a clinical trial; 3) scientific articles with full text available in databases and 4) being in Portuguese, Spanish or English. Among the 23 studies found, 7 met the inclusion criteria. In 6 of the 7 studies found, sending mobile messages was the most effective intervention. Interventions based on mobile text message can become an important tool to increase prevalence of smoking cessation. The inclusion of only three languages was a limitation of this review.
Keywords: Smoking; technology; treatment; literature review.

USO DE MENSAGENS DE CELULAR PARA CESSAÇÃO DO TABAGISMO: REVISÃO SISTEMÁTICA

RESUMO. Formas inovadoras de tecnologias de comunicação, como a internet e o uso de celular, são cada vez mais utilizados para ajudar fumantes a parar de fumar. O objetivo deste trabalho foi realizar uma revisão sistemática sobre o uso de mensagens de celular como forma de intervenção para pessoas que desejam parar de fumar. Pesquisas foram conduzidas nas bases de dados PubMed, Psychinfo, Scielo e Pepsic. Palavras-chave incluíram: ["*tobacco use cessation*" *OR* "*tobacco use disorder*"] AND ["*intervention studies" OR "clinical trial" OR "evaluation studies"*] AND ["*text messaging*"]. Os critérios de seleção dos estudos foram: 1) abordarem o tema mensagens de texto de celular para o tratamento do tabagismo; 2) ser um estudo clínico; 3) artigos científicos com textos completos disponíveis em bases de dados e 4) estar nos idiomas português, espanhol ou inglês. Entre os 23 estudos encontrados, sete preencheram os critérios de inclusão. Em seis dos sete estudos encontrados o envio de mensagens de celular foi a intervenção mais eficaz. Intervenções baseadas no envio de mensagens de celular são uma estratégia complementar ao tratamento do tabagismo que podem contribuir para a cessação tabágica. A inclusão de apenas três idiomas foi uma limitação dessa revisão.
Palavras-chave: Tabagismo; tecnologia; tratamento; revisão de literatura.

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USO DE MENSAJES DE MÓVIL PARA DEJAR DE FUMAR: UNA REVISIÓN SISTEMÁTICA

RESUMEN. Formas innovadoras de tecnologías de la comunicación, como Internet y el uso del teléfono móvil, se utilizan cada vez más para ayudar a los fumadores a dejar de fumar. El objetivo fue realizar una revisión sistemática el uso de envío de mensajes de textos como una intervención para las personas que desean dejar de fumar. Se realizaron encuestas en las bases de datos PubMed, PsychINFO, Scielo y Pepsic. Palabras clave incluyen: ["tobacco use cessation" OR "tobacco use disorder"] AND ["intervention studies" OR "clinical trial" OR "evaluation studies"] AND ["text messaging"]. Los criterios de selección del estudio fueron: 1) abordar el tema de los mensajes de texto móviles para el tratamiento del tabaquismo; 2) ser un estudio clínico; 3) artículos científicos con texto completo disponible en las bases de datos y 4) estar en los idiomas: portugués, español o inglés. Entre los 23 estudios encontrados, siete cumplieron los criterios de inclusión. En 6 de los 7 estudios encontrados envío de mensajes móviles fue la intervención más eficaz. Intervenciones basadas en el envío de mensajes móviles son una estrategia complementaria para el tratamiento del tabaquismo que puede contribuir a dejar de fumar. La inclusión de sólo tres idiomas fue una limitación de esta revisión.

Palabras-clave: Tabaquismo; tecnología; tratamiento; revisión de literatura.

Introduction

Smoking is considered by the World Health Organization (WHO) the leading cause of preventable death in the world. It is estimated that about 1.2 billion deaths are caused by smoking worldwide (World Health Organization [WHO], 2011). Approximately 1 billion men and 250 million women are cigarette smokers or other tobacco users and approximately two-thirds of these smokers are concentrated in only ten countries, including United States, Brazil, China and India (Guindon & Boisclar, 2003; WHO, 2008). Furthermore, smoking is acknowledged as an epidemic that causes physical, psychological and behavioral dependence, similar to what occurs with others drugs use. During the use, smokers inhale more than 4.720 toxic substances, such as carbon monoxide, ammonia, ketone, formaldehyde, acetaldehyde, acrolein, as well as 43 carcinogenic substances, such as: arsenic, nickel, benzopyrene, cadmium, lead, residues of pesticides and radioactive substances (Rosemberg, 2004).

About half of smokers die due to some condition associated with smoking (Henningfield, Fan, Buchhalter, & Stitzer, 2005). In addition, smoking is a risk factor for numerous chronic diseases, cardiovascular diseases and several types of cancers, such as lung, mouth, pharynx among others (Pinto & Ugá, 2010; Siatkowska, Jastrzebski, & Kozielski, 2010). The sooner is the smoking cessation the greater are the benefits of quitting smoking; however, quitting smoking is always beneficial at any point (even after the development of some tobacco-related illnesses), due to the better prognosis and increased quality of life (Henningfield et al., 2005).

Despite the apparent decline in the number of smokers in the last decades, smoking is still considered a public health problem. Data from the Brazilian Institute of Geography and Statistics (IBGE) of 2009 show that 17.5% of the population used tobacco products, which represents 25.5% million people. Following the global trend of decline, according to the Surveillance of Risk Factors and Protection for Chronic Disease by Telephone Inquiry of 2013, the prevalence of smokers in Brazil decreased to 11.3%. The data is three times lower than the 1989 index, when the survey conducted by IBGE showed that 34.8% of the population were smokers. The goal of the Ministry of Health is to reach 9% until 2022 (Instituto Nacional do Câncer [INCA], 2011).

Tobacco is the only legally marketed product that is harmful to anyone exposed to it and can kill more than half of its users. Yet, tobacco use is common around the world due to low prices, massive marketing, lack of knowledge about the damages for the population and inconsistent public policies against use (WHO, 2013). If current consumption trends are maintained, these numbers will increase for approximately eight million annual deaths by 2030, half of them of individuals in productivity age (between 35 and 69 years) (WHO, 2009).

There are several methods to support smokers to quit, such as self-support material, flyers, manuals, group counseling, and much more. In Brazil, traditional forms of smoking cessation

interventions include pharmacological treatment (Nicotine Replacement Therapy, Varenicline and Bupropion), psychotherapeutic counseling, behavioral support or the combination of these techniques (Hartmann-Boyce, Stead, Cahill, & Lancaster, 2013). Although great advances have been made to ensure access of treatment for smokers, there is still a large proportion of smokers that do not receive evidence-based treatment. Data from the Global Adult Tobacco Survey report that 51% of brazilian smokers tried to quit in the previous year of the survey, but only 8% received some form of evidence-based treatment (INCA, 2010). Because of this, the use of complementary strategies of smoking cessation treatments may be pertinent to the brazilian context. Interventions mediated by communication technology, such as mobile phone and internet use may be one alternative to the traditional treatment (Civljak, Sheikh, Stead & Car, 2010).

Currently, the use of communication technology as a type of intervention is being increasingly applied to provide information and support to smokers who want to quit. Mobile phone and text messaging services have been increasingly used for health promotion and prevention activities, especially in developing countries, since 2002 (Head, Noar, Iannarino, & Harrington, 2013). In Brazil, studies on smoking cessation mobile text messages intervention are still unknown. A recent literature review describes few international studies that use mobile phone-based interventions for smoking cessation and none of them used Brazilian population as part of their samples (Whittaker, McRobbie, Bullen, Borland, Rodgers & Gu, 2012). Therefore, the need for more studies in the field is evident and also the need to adapt this kind of intervention to our country's reality, where access to this kind of technology may not be common to the entire population.

Since the introduction of mobile phone networks in the 1980s, the use of mobile phones has grown exponentially. The International Telecommunication Union (ITU) reports that by the end of 2011 there were almost six billion mobile phones subscriptions worldwide, corresponding to a 87% world penetration, and in some countries (for example, United Kingdom and parts of Europe) with more than 100% penetration (ITU, 2011). Telephone use as an intervention strategy has been used in health since 1970, both for screening and for health counseling. Several benefits can be pointed out, such as the speed of the patient's access to the health professional, shortening the waiting time for health appointments, reduction of the time and costs, as well as the possibility of increasing the frequency of contacts and facilitation of patient return (Piette, Weinberger, Kraemer, & McPhee, 2001).

Similar to telephone interventions, counseling programs conducted via internet have also improved since the study conducted by Prochaska, DiClemente, Velicer and Rossi (1993). More recently, mobile text messaging programs began to be used. The "TXT to Quit" program, developed in New Zealand in 2005, is a mobile text messaging program that sends personalized and regular text messages for smoking cessation, providing counseling, support and distraction to smokers to quit. The program offers other services, such as "Quit buddy" - participants with similar characteristics and quit-dates are put in touch with each other -, "TXT crave" - participants could search for text messages on demand by sending a text message to a short code number and they would receive tips to deal with the crave - and "TXT" in which messages were sent to participants on current topics (Rodgers et al., 2005).

The use of text messages for smoking cessation has a great reach because it does not require patients to go in person to the services, promotes interactivity, open new channels of communication between patients and professionals and it is a source of instant access when people are more likely to have lapses and relapses (Fundacion Telefônica, 2012). Therefore, the use of this strategy is a potential tool for comprehensive care, generating expansion of health action and evolution towards traditional care (Piette et al., 2001).

Systematic reviews and meta-analyzes have become increasingly important in health care. According to Liberati et al. (2009), these methods are often used as a starting point to the development of clinical practice guidelines. Systematic reviews can be defined as a review of a clearly formulated issues that uses systematic and explicit methods to critically identify, select and evaluate relevant research, and to collect and analyze data from studies. Therefore, the aim of the present study is to produce a synthesis of the results of studies that evaluated the efficacy of mobile text messaging for the purpose of smoking cessation and to identify the possible effects of these interventions on tobacco control.

Method

Procedures

The systematic review was conducted in the following databases in October of 2014: PubMed, PsycInfo, Scielo and Pepsic. On PubMed, descriptors were extracted from the Medical Subject Heading Terms (Mesh Terms - MeSH), a method of vocabulary control, developed by the U.S. National Library of Medicine. Tobacco-related descriptors were *"tobacco use cessation"* and *"tobacco use disorder"*. Regarding the type of study, the descriptors were *"interventions studies"*, *"clinical trial"* and *"evaluation studies"*. Lastly, *"text messaging"* was the descriptor used to find studies with text messaging intervention. The results from each of the terms were cross-referenced using the boolean operator "AND" in order to restrict the search to the summaries that presented all the terms at the same time.

The eligibility criteria established for this study included: 1) addressing the topic of mobile text messaging for smoking treatment; 2) being a clinical study; 3) scientific articles with complete text available in databases and 4) being available in Portuguese, Spanish or English. There were no restrictions regarding the year of publication of the studies.

The final search consisted of 23 papers. The selection process is described in Figure 1. One article was excluded from the sample because it was duplicated and, after reading the abstracts, eight articles were excluded because they did not address the issue of sending text messages to smokers. In order to increase the scope of the search, we conducted a search in the references of the studies previously added, resulting in two more papers, which were also included in the review. After reading the full texts, nine studies did not meet the inclusion criteria mentioned above and were excluded. After this phase, we conducted the qualitative analysis of the content of the papers. The following information was identified in the studies: authors, year of publication, characteristics of participants (sample, age, country, sex), characteristics of the interventions (theoretical background, frequency and message personalization), main results and follow-up.

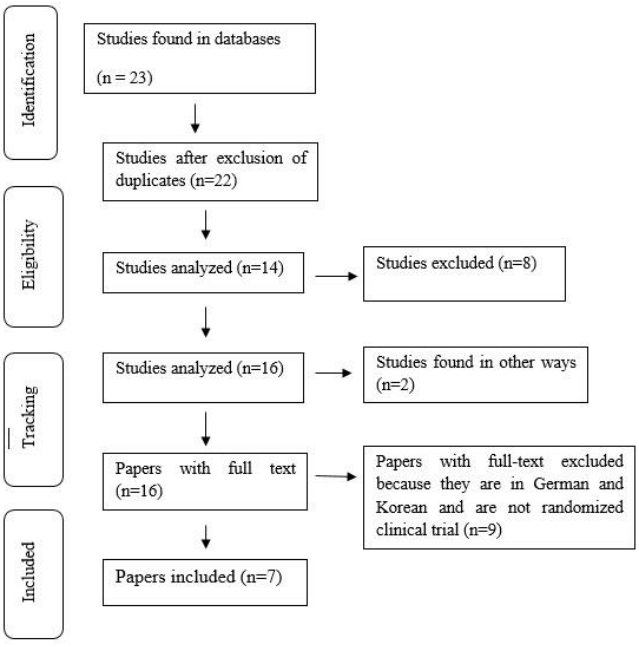

Figure 1. Flowchart of the selection process of the papers included in the study.

Results

From the final sample, three studies were published in 2012, three in 2013 and two in 2014. Three studies were conducted in the United States, two in the United Kingdom, one in China and one in Switzerland. All the papers were written in English. Regarding the population, two papers restricted their samples to pregnant women while the others used samples composed of both sex. The papers presented variations regarding the number of messages and the frequency that the program send the messages. Results are presented in Table 1.

Table 1

Description of the analyzed data

Authors	Buller et al. (2014)	Haug et al (2012)	Naughton et al. (2014)	Naughton et al. (2012)	Pollack et al. (2013)	Shi et al. (2013)	Ybarra et al. (2013).
N	102	755	207	207	31	179	174
Participants	Smokers with age between 18 and 30 years ♀: 59%. United States.	Smokers wirh average age of 18 years. (392 ♀ e 363 ♂). Switzerland.	Pregnant women. England.	Pregnant women. England.	Pregnant women. United States.	171 ♂ e 8 ♀ age between 16 and 19 years. China.	Age between 18 and 25 years (72 ♀ e 29 ♂). United States.
Intervention	108 sent messages. Cognitive Social Theory and a modified verson of the Transtheoria l Model.	12 personalized messages per week for 3 months. Based on HAPA Theory††.	80 personalized messages in 11 weeks. Based on Cognitive Social Theory.	80 personalized messages in 11 weeks. Based on Cognitive Social Theory.	Two interventions : SMS and SMS + SGR†. Up to 5 messages per day for 5 weeks. Standardize d messages.	129 messages based on the Transtheoric al Modelo f the Stages of Change.	31 standardized messages for 2 weeks in the pre-Quit phase. At the beginning of the Quit phase 30 messages. At the end of eQuit, 35.
Follow-up	12 weeks	6 months	6 months	3 months	6 months	12 weeks	4 weeks
Main results	Rate of cessation among those intending to quit in the REQ-Mobile§ group was 18% (7-28%) and ONQ-Text¥ was 31% (18-45%). The effect size (h=0,30).	Rate of cessation (12.5% intervention vs. 9.6% control). OR 1.02 ($CI_{95\%}$ 0.60 – 1.76) for the group that completed the treatment and 1.03 ($CI_{95\%}$ 0.59-1.79) for the group that started the treatment (p>0,05).	45.2% of cessation rate for the intervention group and 40.3% for the control group (OR 1.22; $CI_{95\%}$ 0.88 -1.69).	Cessation rate in the intervention group of 22.9% and 19.6% in the control group. (OR 1.22; $CI_{95\%}$ 0.62 – 2.41).	Cessation rate of 13.4% for SMS+SGR e 7.5% SMS.	7-day reported Cessation rate of tobacco (14% intervention vs. 8% control). In 30 days (10% intervention vs. 7% control) (p>0,05),	Intervention group had abstinence rate of 39% and control group 21% (OR 3.33; $CI_{95\%}$ 1.48 – 7.45).

†Scheduled Gradual Reduction (gradual reduction in the number of cigarettes smoked until reaching abstinence); ††*Health Action Process Approach*; § It is a smartphone application designed to send short messages with interactives tools; ¥Text messaging system.

The development of the messages was personalized in six studies (Naughton et. al., 2014; Pollack et. al., 2013; Shi, Jiang, Yu e Zhang, 2013; Haug et. al., 2012; Naughton et. al., 2012; Ybarra et. al., 2013), while only one sent standardized messages to smokers (Buller et al., 2014). Personalized messages were considered as messages based on each participant's needs and interests, including their motivation, reasons to quit smoking, benefits and plans to deal with abstinence. The standardized messages were developed by the platforms and did not take into account participant's characteristics.

The studies used different theoretical background. Three papers (Buller et. al., 2014, Naughton et. al., 2012; Naughton et. al., 2014), used the Cognitive Social Theory, which identifies self-efficacy as a determinant of conduct (Bandura, 1986). Self-efficacy can be understood as the belief individuals have about their ability to successfully perform certain activity. Therefore, this belief may affect their choices (Bandura, 1994). Two interventions used Health Behavior Models as a theoretical basis, however they used different terms (Haug et al., 2012; Shi , Jiang, Yu, & Zhanget, 2013). Health Behavior Models can be understood as a pattern of factors that can improve motivation and eventually lead to a change in sustained behavior (Schwarzer, 2008). Haug et al. (2012) used the Health Action Process Approach (HAPA) and Shi, et al. (2013) used the Transtheoretical Model of Behavior Change by Prochaska e DiClemente (1982). This model suggests a distinction between the process of motivation, resulting in the definition of goals and process of volition that lead to real health behavior. The approaches combine three inactives stages (precontemplation, contemplation and preparation) and two active stages (action and maintenance). Within the two initial stages of outcome expectation, perceived risk and perceived self-efficacy are important social-cognitive predictors for the development of an intention to action. Within the subsequent intentional phase (preparation), planning processes are crucial to achieving the desired action. Once the action started, the self-regulatory skills are important to maintain healthy behaviors (Schwarzer, 2008). Lastly, two papers did not explain the theory on which their interventions were based (Ybarra et al., 2013; Pollak et al., 2013). In addition, the follow-up period between studies differed significantly. In Buller et al. (2014) and Shi et al. (2013), follow-up was performed in 12 weeks. In Haug et al. (2012) and Naughton et al. (2014), follow-up was conducted in six months. Naughton et al. (2012) performed the follow-up in three months. Pollack et al. (2013) performed it in six weeks and Ybarra et al. (2013) in four weeks.

Regarding the main results, the studies were different from each other, regarding the main outcomes and the cessation period evaluated. In Buller et al. (2014), the cessation rate was assessed in twelve weeks after the baseline and showed that the text message group had 31% of abstinence, while the smartphone application group had 18%. In Haug et al. (2012), the abstinence rate after six months was higher in the intervention group (12.5%) than in the control group (9.6%). This outcome suggests the intervention reduced the number of smokers regardless their motivation to quit smoking. In the study by Naughton et. al (2014) the abstinence rate after six months was 45.2% in the intervention group and 40.3% in the control group, suggesting that the intervention through the *iQuit* program of mobile messages was more effective than the usual care received in the control group. In Naughton et al. (2012), the cessation rate in the intervention group was also higher than in the control group in the 3-month follow-up, with 22.9% and 19.6% respectively. In Shi et al. (2013), although the differences were not significant, the intervention group had a relatively higher prevalence of abstinence at 30 days from the baseline (10% vs. 7%). Finally, in Ybarra et al. (2013) after four weeks, the intervention group had a higher abstinence rate (39%) than the control group (21%), suggesting that text messages may be considered an effective intervention for smoking cessation.

Another point worth noting is the studies' intervention techniques. Shi et al. (2013), Naughton et al. (2012) and Haug et al. (2012) used only text messages. Pollak et al. (2013) used text messages and a gradual reduction program that extents the the between smoked cigarettes. Smokers could be encouraged to smoke when they do not want to smoke (for example, a random time in the morning) and may not be required to smoke when they want to smoke (for example, after a large meal). Smoking becomes disconnected from triggers and they need to work through times of craving. Ybarra et al, (2013) used two components of the program *"TXT to Quit"* (Rodgers et al., 2005) in addition to the text

messages, the *"Quit buddy"* and *"TXT crave"* that helps in moments of craving. A website (Stopmysmoking.com) was also used, which provided additional closure features, technical support, and a discussion forum for participants. Naughton et al. (2012) used text messages and self-support brochures. Finally, Buller et al. (2014) used text messages and a smartphone application. Through the application, smokers could create lists of reasons to quit, quit benefits, plans to deal with challenging situations and stressful circumstances and also listen to ex-smokers' audio testimonials.

Almost all of the studies had a higher cessation rate in the intervention group (text messages). The exception was Pollak et al. (2013), who used a combined intervention between "Scheduled Gradual Reduction" (RGP) and text messages in one group and only text messages in the other group. After the follow-up period, the group that used the combined intervention was more effective in terms of cessation and reduction (13.4%) than the arm that only received text messages (7.5%).

Discussion

The objective of this review was to analyze empirical studies that evaluated the use of mobile text messages as a tobacco cessation intervention for people who want to quit smoking. Our findings suggest that this topic is quite recent, since the final result of the search consisted of only seven studies, and the oldest year of publication was 2012.

In general, text messages were effective in the studies found, which can be confirmed by higher rates of the abstinence in the groups that received the messages when compared with the control groups, in six of the paper found. This fact suggests that this form of treatment may be an effective intervention method for tobacco control. It was also observed that the number of messages sent and the delivery frequency was also different among the studies, as well as the cessation outcomes. Cessation rates generally increased as the frequency and the number of messages were higher. Studies that triggered more messages and more frequently achieved higher abstinence rates when compared to other studies. Furthermore, the abstinence rate also increased when messaging was combined to other interventions, such as the Scheduled Gradual Reduction. Given these results, it is suggested that text messages are effective, and the cessation rates increase depending on the number and frequency of which they are sent. Text messages used as a complementary tool to traditional treatment also seems to increase cessation rates.

The studies presented differences among the main outcomes and the cessation period evaluated, which is commonly also found in conventional smoking treatments (Jain, 2003). Because this is a recent subject, with few researches from the technological perspective, (Whittaker, McRobbie, Bullen, Borland, Rodgers, & Gu., 2012) there was not agreement on the theoretical basis. As mobile use has become increasingly widespread, efforts to use mobile technology for *mHealth* have increased significantly (Pew Research Center, 2012). According to our analysis, most studies had abstinence rates or smoking reduction higher when using text messages than other types of interventions, for example, the Scheduled Gradual Reduction in the study by Pollak et al. (2013).

This study presented some limitations. First, as the inclusion criteria included only studies in Portuguese, Spanish and English, papers that used other languages were not captured by the search. Second, we did not include smartphone applications that send text messages. There is an increasing number of people getting used to smartphones and often even exchanging text messages using some instant messaging applications. Studies that use these techniques may not have been reached in the search. Despite the limitations inherent to the methodological choices adopted in this review, the systematization of the process allows this study to be replicated in the future, allowing comparisons with the results presented here.

Finally, most of the analyzed studies were conducted in developed countries, where the access to mobile technology is substantial. We recommend that future studies should be conducted in developing

countries, such as Brazil, where access to mobile technology is still limited to a part of the population, that knows how to operate receiving and sending text messages. Second, we suggest that studies on the cost-effectiveness of mobile technology interventions should be conducted. As already mentioned earlier, it is well known that an increasing number of researchers is developing health interventions through mobile technology.

Final considerations

According to the main aim of this review, we found that interventions conducted through text messages to smokers who want to quit, can be considered effective for smoking cessation. The results show that the higher the frequency and the number of the messages sent, the higher the cessation rates in the intervention groups. Abstinence rates increased when text messages were associated with other intervention techniques. There is also an important result regarding sex in the study sample. Among the seven papers included in the study, the sample only had women in three of them, and the remaining four had women as the majority of the sample. This fact suggests that women may be seeking more information and health service than men.

In conclusion, due to the aforementioned limitations, the studies found are still not sufficient to demonstrate for the evidence on the effectiveness of this type of intervention, requiring greater future studies to analyse this topic more deeply, with the ultimate goal of promoting cessation.

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