Improving Efficiency and Capacity in Primary Health Care in Iceland Using System Dynamics

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Abstract

A system dynamics model was developed to identify the determinants of effectiveness in treatments for mood and anxiety disorders by exploring their long-term effects. This was done by using respective literature and extensive knowledge and experience from specialists in the field. The main results are that it can be demonstrated how current treatment with medications can lead to accumulation in the system, with little short term benefits for patients but long term loss, both for the patient and for the entire health care system.

When it comes to policy changes in health care management regarding treatments for mood- and anxiety disorders, Cognitive Behavior Therapy (CBT) is recommended as an alternative for the primary health care. This evaluation is based on results of modeling the existing system with CBT as an option. CBT entails clear benefits and is an optimal choice, compared to the current state of system, when the objective is to help as many patients as possible in the most effective way without increasing the cost of treatments. Increased emphasis on resources like CBT, for patients with mood- and anxiety disorders, can enhance patient's quality of life resulting in significant cost benefits for the society.

Key Words *Health Care, System Dynamics, Mood and Anxiety Disorders, Medication, Cognitive Behavioral Therapy (CBT)*

Introduction

Common mental health disorders, such as mood and anxiety disorders may affect up to 15% of the population at any one time (Wittchen and Jacobi, 2005; Kessler, Berglund et al., 2005; Kessler, Chiu, Demler and Walters, 2005). These disorders can have a lifelong course of relapse and remission and all can be associated with considerable burden such as reduced labor participation, additional sick days and lower quality of life as well as significant long term disability (Moussavi et al., 2007; Deacon, Lickel and Abramowitz, 2008; Creed et al., 2002; Davidson, 1996; Gladis et al., 1999; Mendlowich and Stein, 2000; Olatunji, Cisler and

Tolin, 2007). The vast majority of depressive and anxiety disorders that are diagnosed are treated in primary care (Spitzer et al., 1999; Lefevre et al., 1999, Rucci et al., 2003; Ansseau

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et al., 2004). However, many individuals do not seek treatment and these disorders often go undiagnosed. The most common method of treatment for common mental health disorders in primary care is psychotropic medication. This is due to the limited availability of psychological interventions, despite the fact that they are generally preferred by patients and also recommended in national guidelines (NICE, 2004, 2005, 2007, 2009).

Treatment with medication often involves higher recurrence rates in primary care due to side effects. The result can be a prescription of a different kind of medicines or additional medicines which are intended to reduce side effects. This process is repeated again and again until the right combination of a drug dose is found. As a result, this process can turn into a vicious circle, leading to a cure that perhaps is worse than the original disease.

A therapy that has been known for its effectiveness in helping patients with those disorders is a Cognitive Behavior Therapy (CBT). CBT is a form of psychotherapy in which the therapist and the client work together as a team to identify and solve problems. Therapists use a Cognitive Model to help clients overcome their difficulties by changing their thinking, behavior and emotional responses. Cognitive therapy has been found to be effective in more than 1000 outcome studies for a myriad of psychiatric disorders, including depression and anxiety disorders. It is recommended in NICE (National Institute for Health and Care Excellence) guidelines as a priority therapy for sub threshold symptoms and mild to moderate common mental health disorders (NICE, 2004, 2005, 2007, 2009).

Given this, it was interesting to explore further the cause of difference in treatment effectiveness and also to portray the result of a new focus in health care management. The system dynamics methodology seemed particularly appropriate here since it focuses on dynamic problems arising in complex systems, such as interdependence, information feedback, and the generation of actionable model based insights (Sterman, 2000).

System Dynamics Research in Health Care

Systems in health care are often very complex. They usually contain many different stakeholders with different backgrounds, perspectives and opinions on priorities for managing the systems. In recent decades, studies where dynamic systems methodology is applied to a particular health case or health system, have increased significantly. Literature focusing on policy and management in health care include patient flows in emergency and extended care (Royston, Dost, Townshend and Turner, 1999; Lane, Monefeldt and Rosenhead, 2000; Wolstenholme, 1996, 1999) and studies on public health planning (Hirsch and Immediato, 1999; Hirsch and Homer, 2004, 2005; Homer and Milstein, 2004).

Homer and Hirsch (2006) believe that in many cases the challenges of dynamic complexity in public health may be effectively addressed with the systems modeling methodology of system dynamics. That the Microworld's comprehensive view of health status and health care delivery may provide insights that are not available from approaches that focus on one component of the system at a time. This is true here where two different groups of stakeholders see things from their own perspective. When examining strategies for improving health status, Homer & Hirsch (2006) believe that users can get a better sense of how a focus on enhanced care of people with chronic illnesses can provide short term benefits in terms of reduced deaths, hospital admissions, and costs, but how better long term results can be obtained by also investing in programs that reduce social and behavioral health risks. This

study deals with exactly this; to examine whether providing therapy in health care with a focus on enhanced care can result in short- and long-term benefits?

The case

This study was limited to mild to moderate cases of mood and anxiety disorders in Iceland. The two therapies considered here are medications and cognitive behavior therapy on an individual basis. They were chosen mainly because they are recommended in NICE guidelines as a mechanism for improving outcomes for those particular disorders.

Mood and anxiety disorders are considered to affect about 10% of the Icelandic population every year. Year prevalence has not increased in recent years and there is little evidence that mental health problems are less frequent in Iceland compared to neighboring countries (Stefánsson and Líndal, 2009). These disorders can have great negative effect on people‘s daily life such as the social and vocational competences, physical health and mortality. The mental and emotional impact can also significantly reduce the ability of individuals to work effectively, leading to less income and lost contribution to society in the form of taxes and work (Moussavi et al., 2007).

These disorders are a growing health problem associated with considerable functional impairment and economic costs related to lost productivity and treatment (Deacon, Lickel and Abramowitz, 2008, Creed et al., 2002, Davidson, 1996). In recent years mental disorders have been the most common cause of disability in Iceland (Thorlacius, Stefánsson and Ólafsson, 1998; Thorlacius, Stefánsson and Jóhannsson, 2001, 2003; Thorlacius and Stefánsson, 2004; Thorlacius, Stefánsson, Ólafsson and Rafnsson, 2001). More than one third of all individuals who receive full disability pension are due to mental disorders (37%) (Tryggingastofnun, 2010) and they are considered to cause more job losses and costs for society than any other disease.

Treatments

With medications the aim is not to treat the disorder itself, but instead only mask the symptoms. If medication is discontinued, the symptoms will generally return if psychotherapy has not been provided. However, side effects, a high incidence of recurrence and relapse, poor treatment adherence, submission and a long time before significant impact of these drugs reveal are the major disadvantages of the treatment (Kent, 2000; Hirschfeld, 2003; Wilson, 2009; Masand, 2003; Sussman et al., 2001).

The main essence of cognitive behavior therapy (CBT) is to map the skewed assessment that individuals have on environmental conditions or internal stimuli due to their experience, that they have developed and causes their experiences and feelings to become unilaterally and negative (Beck, 2005). As a result it can be explained why a person is struggling with mental illness and therefore provide appropriate assistance in changing behavior and learning slowly to control their emotions, thoughts and behaviors. Then their condition starts to gradually improve and people gain more confidence in their capabilities (Beck, 2005).

Uneven success of the two treatments gives rise to explore realistic policy change in health care with the aim of most people reaching a long-term recovery, resulting in significant cost benefits for the whole society.

Data gathering

In the first phase of the study data was sought from the respective literature. Then a focus group was established and interviewed on an individual basis. This focus group consisted of experts in the field, both doctors and psychiatrists in Landspitali University Hospital (LUH) and also a psychiatrist working in an Icelandic anxiety treatment center. Members of the focus group were chosen with respect to their interest, experience and knowledge in handling mood- and anxiety disorders as well as knowledge of the advantages and disadvantages of treatments available. Data gathering took place in April – September 2010.

Causal loop diagrams (CLD)

To better understand how the treatments differ they were mapped using causal loop diagrams. Based on the dynamics demonstrated in those causal loop diagrams, a simulation model was constructed to show the flow of patients throughout the treatment process.

Medication

The main goal with medication is to achieve as long remission as possible. The time until significant impact of these drugs is revealed can range from 4–6 weeks and it can take up to 12 weeks until optimal impact has been reached (Wilson, 2009). The core of medication as a treatment for mood and anxiety disorders is shown in figure 1. The loop shows how medication is not meant to treat the disorder itself but instead only mask the symptoms. When those symptoms are minimized the patient experiences wellness, he becomes more active in daily activities and social skills become normal so that the ability to cope with life again has been increased. This works like an incentive for the treatment adherence and the medication continues.

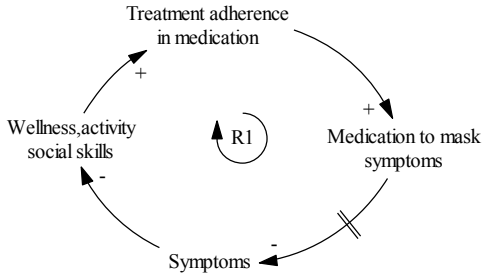

Figure 1: The core of a treatment with medication.

This is the main goal of a treatment with medications. But there are disadvantages that can put the whole treatment in danger. Side effects are a huge disadvantage. When a patient experiences side effects there are mainly two things that can happen. Either he quits on medication or he reports about the side effects and in turn gets either a new prescription to a different kind of drugs or is prescribed drugs intended to lower those side effects. If medication is discontinued, the symptoms will generally return.

Another disadvantage is a high incidence of recurrence and relapse (Masand, 2003). This can also lead to a submission or, if reported, a different kind of drug prescription, to one or more types of medicine. Studies have shown that up to 30% quit medication due to substandard performance, side effects or other disadvantages, regardless of drug type (Masand, 2003;

Kent, 2000; Hirschfeld, 2003; Wilson, 2009). Therefore all efforts are aimed at maintaining treatment adherence to keep up medication.

Adaptation of treatment is an example of a goal seeking behavior. It shows how a reduction in adherence may cause even greater need of new drug or a different combination of drugs, resulting in a bigger and often more complicated dose. Parallel to this adaptation is a reinforcing loop. By changing or increasing doses the medication gets more complex causing a reduction in the adherence. These loops are shown in figure 2.

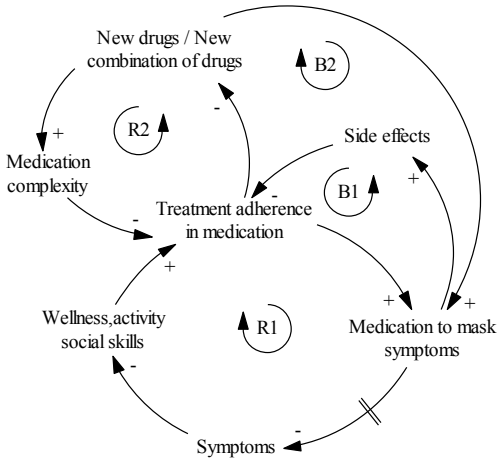

Figure 2: Factors influencing medication.

When patients on medication start to feel better it can cause a premature conclusion that the illness no longer exists. Subsequently the patient stops taking their medication and symptoms return. To address this problem, and other risk factors that interfere treatment with medication, studies have shown that main reasons for low treatment adherence can be due to little information about the drugs and their use along with the prescribers follow up, limited communication between patient and the prescriber, prescribed treatment doesn‘t meet the patient’s needs, too low dose and inadequate treatment duration, negative attitude towards medication, no appreciable recovery characteristics (common in the first 2–4 weeks), poor social safety status and high costs of medications (Masand, 2003). It is also believed that more detailed analysis on the patient’s illness in the beginning improves the quality of treatment since it then meets the needs of the individual and can greatly reduce the disorder (Helgason, 1999). Figure 3 captures these external variables. Respective simulation model part is shown in figure 4.

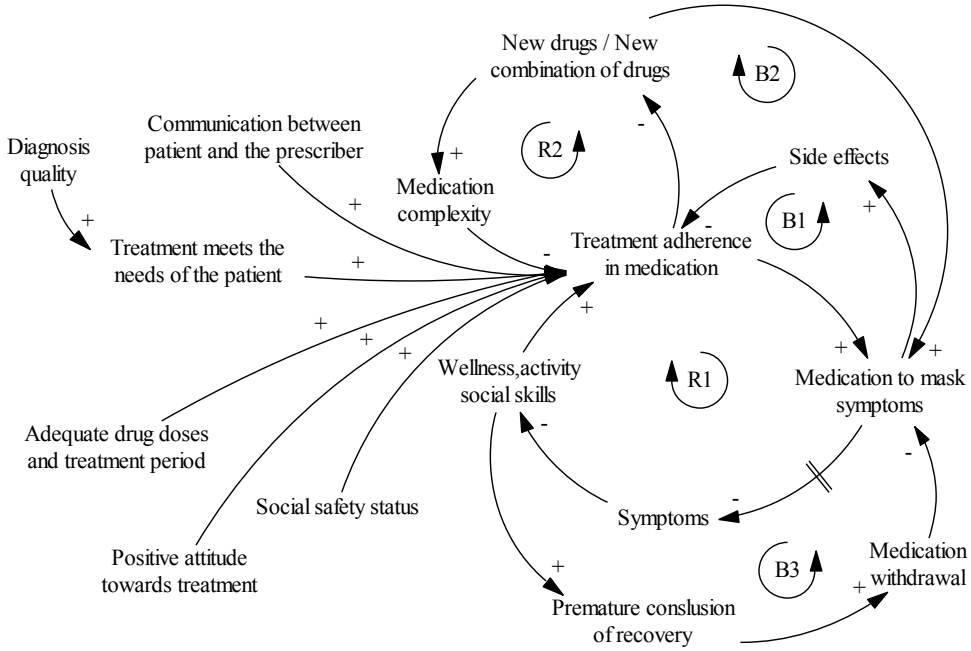

Figure 3: External factors influencing treatment adherence.

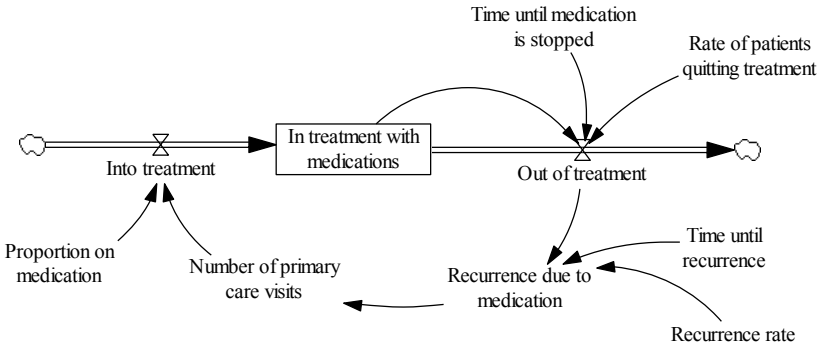

Figure 4: Stock Flow diagram of a treatment with medications.

Cognitive Behavior Therapy (CBT)

The main goal of cognitive behavior therapy is to help the patients to change their behavior and learn slowly but surely to control their emotions, thoughts and behaviors. This tutorial is considered to lead to a better health and greater confidence in patients own ability and therefore the treatment is generally considered to be the most effective solution regarding thoughts, quality of life and satisfaction of individuals (Boschen and Oei, 2009; Butler, Chapman, Forman and Beck, 2006; Otto, Smits og Reese, 2004). The treatment length is usually measured in numbers of interviews with a therapist, in most cases 16–20 times, covering about 3–4 months.

Causal loop diagram was developed to highlight the main purpose of the treatment, see figure 5, and respective simulation model part in figure 6. The CLD shows how mapping the cause of the problem increases the correction of unhelpful behavior and skewed view on the

situation, resulting in a positive change in thoughts and behavior. Subsequently the treatment adherence increases so that attendance to interview sessions is maintained resulting in further mapping. As in the medication, significant treatment effect is not revealed immediately so there is a delay between those variables.

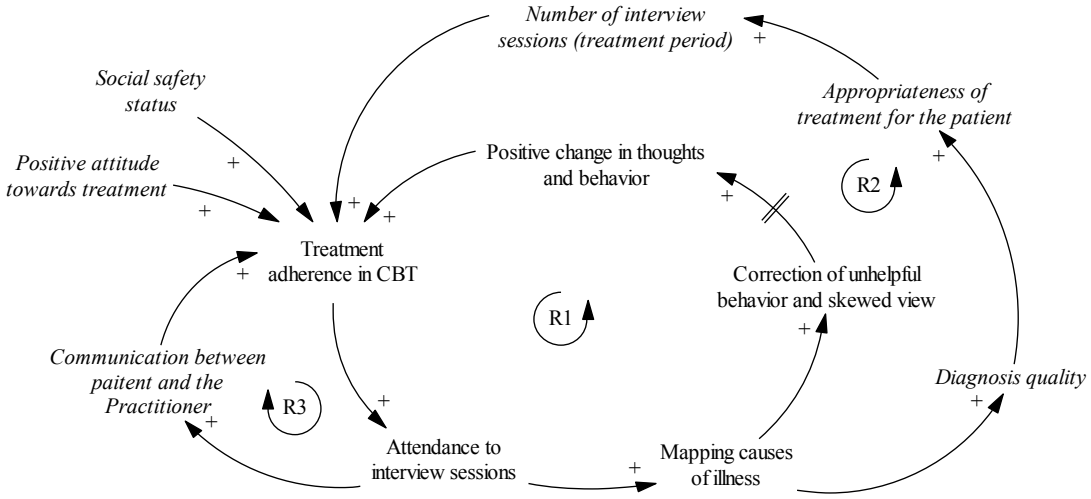

Figure 5: The core of a treatment with CBT.

Within the treatment there are no factors that interrupt the adherence directly like in treatment with medications. What characterizes CBT, however, is that most of the external variables that were considered to have a positive impact on adherence in treatment with medications are inherent in the treatment attributes of CBT. These attributes are shown in figure 5. The two variables, social safety status and positive attitude towards treatment, are still external variables.

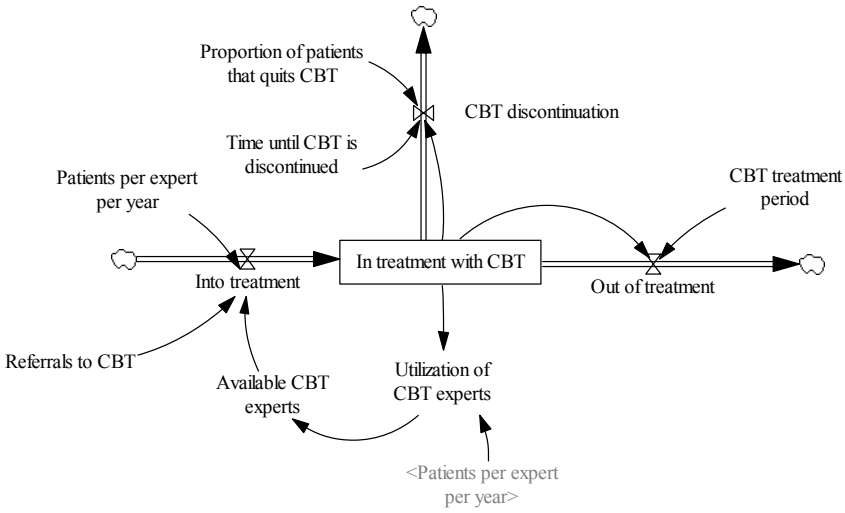

Figure 6: Stock Flow diagram of a treatment with CBT.

Impact on primary health care

Since the vast majority of depressive and anxiety disorders that are diagnosed are treated in primary care, it was interesting to map the impact due to those treatments. Most of the reasons why patients visit the primary health care were considered here, in terms of treatment, based on data from the corresponding literature and information from the interviews. Causal loop diagram of the impact on primary care is shown in figure 7 and respective simulation model part is shown in figure 8.

Treatment based on medications causes higher recurrence rates due to possible side effects, relapse, changes and renewal in drug dose prescriptions, among other reasons. CBT may on the other hand reduce significantly the impact on primary health care since the main cause for recurrence in primary health care is related to relapse. However, this recurrence rate is low among patients who complete full treatment and occurs fairly long time after treatment completion (Westen and Morrison, 2001; Barlow, Gorman, Shear and Woods, 2000; Linden et al., 2005).

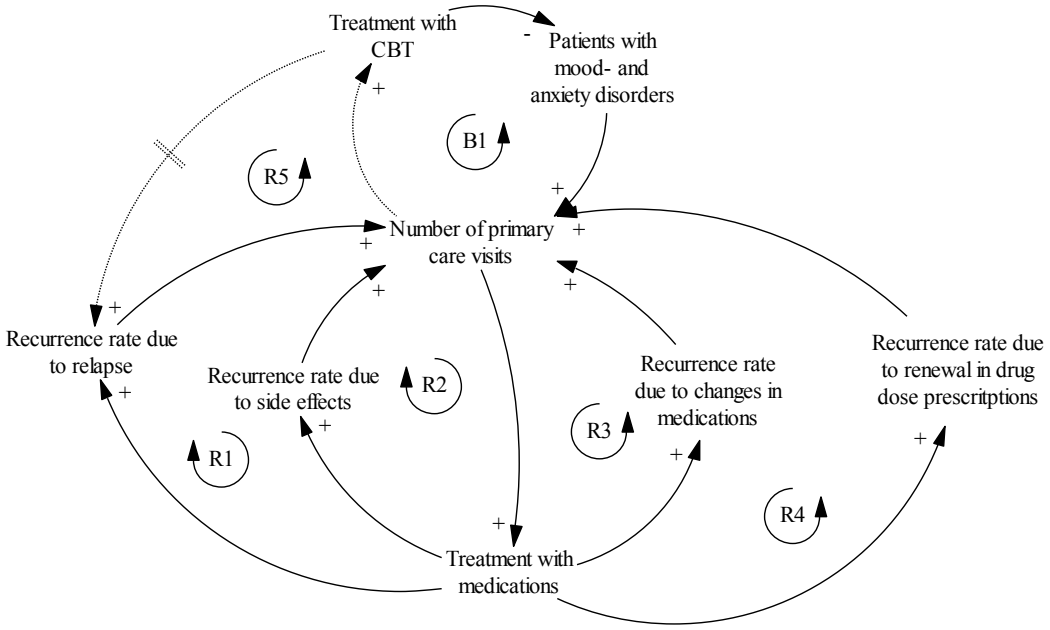

Figure 7: Impact on primary health care.

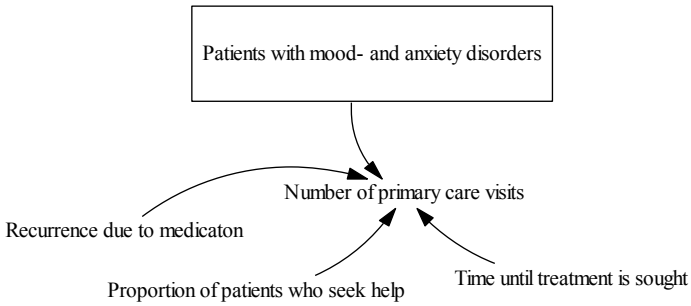

Figure 8: Stock Flow diagram of impact on primary health care.

Analysis and recommendations

When analyzing the effects of policy changes in health care, taking into account CBT, three scenarios of the system were made and examined by looking at the number of the patients (cases) for each scenario.

The first scenario (Policy change 1) was an extreme reversal where the rate of patients starting medication was minimized to 10% and all other patients visiting the primary care due to mood and anxiety disorders were sent to CBT. The second scenario (Policy change 2) was a 50/50 split and the third scenario (Policy change 3) was a change over time, reducing the amount of patients receiving medications and increasing those who are sent to CBT, resulting in a 20% on medication and 80% in CBT after 8 years. The base case (with no CBT) and the three scenarios are shown in figure 9 and corresponding annual cost in figure 10.

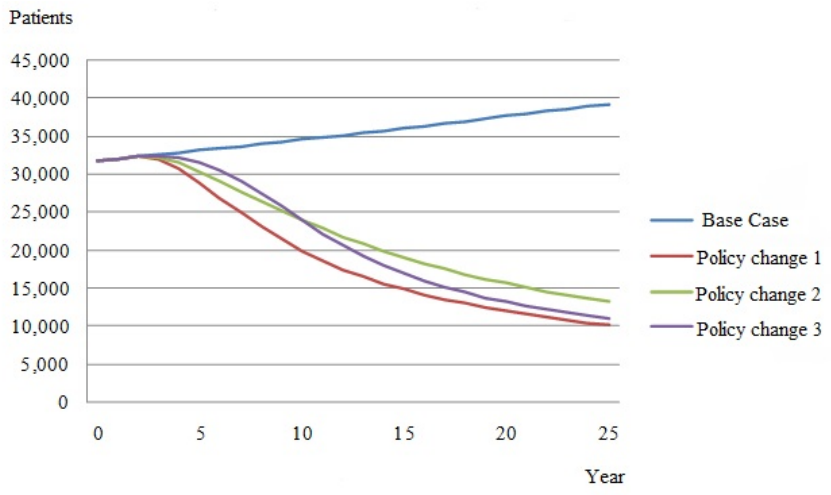

Figure 9: Number of patients with respect to different strategies.

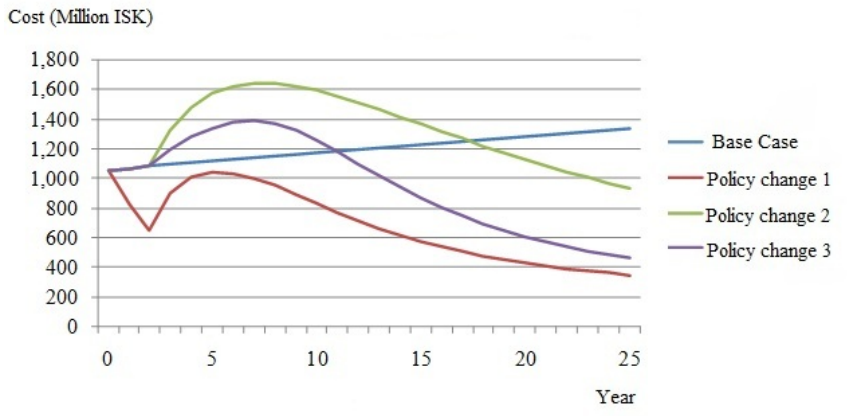

Figure 10: Annual cost with respect to different strategies.

The cost comparison is based on the government‘s participation in pharmaceutical costs on a yearly basis and the costs (estimated) associated with employing numbers of CBT experts, also on a yearly basis. It is notable that despite the fact that the annual cost of policy 3 exceeds the cost of base case in years 2–12 it decreases considerably over the following years (12–25), resulting in only 40% of the cost that base case will entail.

The analysis examines the impact of limiting the number of CBT experts to reflect realistically how many experts the health care system could employ and how this will affect the system and its performance. With no limitation the system ends with 35 experts (after 50 years). Limiting the number of CBT experts to 35 in the beginning did not have a significant impact on reducing the number of patients. The minimum number of experts that needs to employ while achieving improvements in efficiency with respect to number of patients and costs, was found to be 75 experts. Limitation of 100 experts was also examined. These limitations and their impact on the number of patients are shown in Figure 11. By limiting the number of CBT experts both cost and numbers of patients can be reduced significantly.

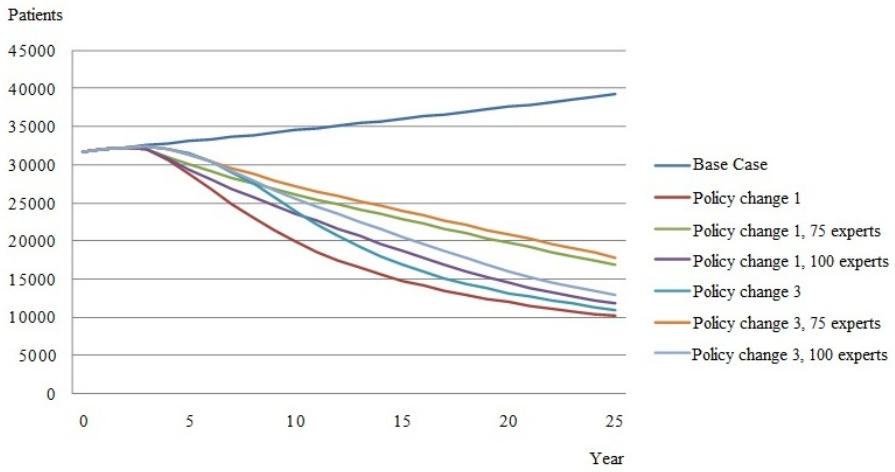

Figure 11: Number of patients with respect to different strategies and limitations.

Given the current arrangements it can be expected that the number of patients on medications will continue to increase and may reach nearly forty thousand after 25 years, resulting in an increase in annual costs by 50% over the period. At the same time, individuals may not receive the appropriate treatment which can lead to further increase in illness severity.

Although the simulation model gives a simplified view of reality and must be verified by experts, it provides an important understanding of specific aspects of the system. Firstly, the characteristics of treatment with medication are reflected in the emphasis on improvements in treatment adherence. Increased adherence involves increased medication to achieve as long remission as possible, causing increase in cost of the treatment since medication is meant to mask the symptoms but not to treat the disorder itself.

Secondly, the simulation model indicates that although cognitive behavior therapy involves higher costs, on an individual basis, it will in the long run lead to significant savings. This conclusion is interesting since this policy change is not just about changing focus, in which individuals receive appropriate treatment for their illness, but also creates efficiencies in the healthcare system.

Conclusion and Discussion

The goal of this research was to develop a system dynamic model to identify the determinants of effectiveness in treatments for mood and anxiety disorders by exploring their long term effects. A system, possibly evolving in the wrong direction and therefore requires intervention, was mapped by means of systems modeling and analysis combined with the use of respective literature and interviews with practicing professionals in the field. While implementation challenges to this efficiency improvement exist, it can lead to long term improvements that can demonstrate considerable financial benefits.

Further studies, where interviewing more diverse group of professionals, should focus on better understanding the development of patients that do not seek treatment or do not receive adequate treatment since it is important to intervene before the illness becomes more serious and therefore requires a different kind and more demanding treatment.

In addition to the more detailed version of the model there is also a need for detailed cost analysis, similiar to the one Layard and colleagues (2006) have carried out for the UK. Such analysis can highlight the benefits for the society when using Cognitive Behavioral Therapy for individuals who struggle with mild to moderate mood and anxiety disorders.

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