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Abstract

Our aging population presents a huge challenge especially to our Western (public) health care systems and costs. Recent developments in the area of e/mHealth solutions hold some promise, especially if they are used in lifestyle interventions for several of the main Western diseases. We raise the question how e/mHealth solutions can help improve health by supporting lifestyle interventions? By using a design analysis approach and based on medical literature on health interventions, we raise a number of questions, which span the problem space: Which types of lifestyle interventions are more or less effective in generating health improvements? Which contents and formats of lifestyle interventions hold promise? What could e/mHealth care solutions contribute? System Quality and Information Quality issues are illustrated by using cases. Finally, in the discussion we briefly address the integration with traditional health care provisioning. Regarding the support of health (self-)management, we argue that specific e/mHealth care approaches could offer solutions for current system quality and information quality challenges. These solutions can in turn offer opportunities for care providers to improve the success of their patient recovery programs, and for patients to improve their health significantly. We provide a list of examples for such support provided by e/mHealth care approaches, e.g. integration with the increasing range of health applications in everyday life (on iPhone, Wii, Google, Nike+ and others). A significant number of patients want to actively contribute to improve their health and fight their disease, if they see that it makes a difference. A growing range of e- and m-Health applications is helping them do so.

Keywords: eHealth, mHealth, lifestyle intervention, prevention, chronic disease, health improvement

1 Introduction

Our aging population presents a huge challenge to our Western economies and specifically to the health care systems: growing needs and costs versus a shrinking labour force able to finance these. Moreover, in the age groups of approximately 50 years and older, diseases like cardiovascular disease (CVD), cancer, diabetes type 2 (often called 'age-onset') and obesity are becoming epidemic. Since world war two, these pandemics have become worse, rather than better (Campbell & Campbell-II, 2006; Ornish, 2008). In the US, by age 65 the majority of people suffer from two or more chronic diseases (Robbins, 2007). These facts represent huge suffering for the individuals and families involved and fit poorly with our ideals about 'enjoying retirement.'

Extensive lifestyle interventions towards healthy living can help reverse or prevent some of the most common diseases facing our aging population: cardiovascular diseases (Ornish, Brown, Scherwitz, & al., 1990; Ornish, Scherwitz, Billings, & al., 1998), diabetes (Anderson, 1986; Tuomilehto, Lindstrom, Eriksson, Valle, & . 2001), obesity (Nicholson, Sklar, Barnard, Gore, & al, 1999; Shintani, Hughes, Beckham, & O'Connor, 1991) , some cancers (Chan & Giovannucci, 2001; Hildenbrand, Hildenbrand, Bradford, & Cavin, 1995; O'Keefe, Kidd, Espitalier-Noel, & Owira, 1999; Ornish, Weidner, Fair, & . 2005; Pierce, Natarajan, Caan, Flatt, & al, 2009; Youngman & Campbell, 1992) and even dementia (Clarke, Smith, Jobst, Refsum, & al, 1998; Grant, 2001). One promising area is 'secondary prevention', which starts from the moment of diagnosis and is aimed at prevention or reversal of disease progression. It connects to patients' motivation to take ownership of their health and make improvements specifically around the time of diagnosis (Stull, Snyder, & Demark-Wahnefried, 2007; Vale, Jelinek, Best, Dart, & al, 2003).

Realizing these trends and in the light of advances in technology development, eHealth and mHealth solutions may hold some promise. Not just to help people living at home longer, like in the many home-monitoring support approaches (e.g. ref Hampe et al). But most notably when e/mHealth support can be used to prevent or reverse diseases by improving health behaviours and outcomes. This connects to the trend of the rapidly growing number of e/mHealth applications that are designed for encouraging and monitoring healthy behaviour as well as providing fun at the same time. Our research objective is to explore what contribution e/mHealth can make to postponing or reversing some of our main age-related diseases. Given this objective, this is a theory inspired positioning paper exploring the design space and potential for eHealth and mHealth rather than a rigorous conceptual or empirical research paper.

Thus, the main research question is: How can e/mHealth solutions help improve health by supporting lifestyle interventions?

2 Method

Our research question is a design question. And the aim of this paper is to conduct a design analysis. The analysis is an example of design research rather than design science (Vaishnavi & Kuechler, 2004). Design science aims at generating knowledge on design, design research aims at generating (domain specific) knowledge for solving a given problem. By contrast, our analysis focuses on a specific design problem (using e/mHealth for health improvement interventions) and the structure of its 'problem

space' (Cross, 1994). Outside of our scope is the detailed design of a specific solution or any taxation scheme for e/mHealth prototypes and products.

Our analysis will follow design cycle phases 1 and 2 of (Verschuren & Hartog, 2005): '1. first hunch' and '2. assumptions and requirements'. The design problem at hand aims to create specific support for people who want to make healthful lifestyle changes when faced with major life (-threatening) events like a heart attack or a chronic disease. Our 'first hunch' opening up the design cycle predicates that e/mHealth solutions may promote healthful behaviours and support health (self-)management. This has lead to the central question of this paper.

To answer our main question it has to be broken down in sub-questions. Thus our main question regarding the e/mHealth potential for reducing age-related diseases will be covered via the following list:

1. Which types of lifestyle interventions are more or less effective in generating health improvements?
2. Which contents and formats of lifestyle interventions hold promise?
3. What could e/mHealth solutions contribute?

The potential of e/mHealth contributions will be explored using the System Quality and Information Quality concepts (Delone and McLean 1992, Lee 2002) and by applying these concepts to two existing e/mHealth examples. System Quality in the health domain relates to delivering integrated health (self-) management across stakeholders and how well the information systems support this. Information Quality relates to (near-) continuous monitoring and guiding of health behaviours as well as outcomes, assuring high relevance, accuracy and conciseness, thus leading to mutual trust of all participants involved. This is most likely supported by using mobile devices connected to available communication networks. As consequence sharing of all biometric measurements and even more subjective data elements (e.g. responses from questionnaires) will be available if requested and accepted.

3 Analysis

In sections 3.1 to 3.3 we answer the three research sub-questions of this paper as formulated above. In section 3.3 we use two case illustrations for the e/mHealth System Quality and Information Quality issues (which pose opportunities as well as challenges). This provides a basis for the discussion and conclusion (section 4), where we briefly discuss the non-trivial configuration of sometimes antagonistic interests when trying to integrate e/mHealth applications into regular health care planning schemes.

3.1 Which interventions are effective for improving health?

In this section we analyse the health intervention effectiveness question by addressing three different distinctions that can be found in the types of interventions that can be devised. In (Simons & Hampe, 2010) a wide range of health interventions is reviewed. Some of the main differences between those interventions are: ambition level (moderate versus extensive changes), broadness of the intervention (using many health factors simultaneously or only one) and whether the aim is to promote healthful behaviours before or after disease onset (which is the difference between primary and secondary

intervention). Hence, we address these three distinctions below. At the end of the section, Table 1 summarizes the answers to these three questions:

1. Moderate versus extensive lifestyle interventions?
2. Broad versus narrow (e.g. only exercise or only supplements) interventions?
3. Primary versus secondary prevention interventions?

The answer to question 1, how extensive should lifestyle interventions be, depends on subjective priorities. Some want to make recommendations that virtually everybody is willing to accept. They generally promote moderate lifestyle changes. If however the aim is to reverse disease, then extensive lifestyle changes are preferable, since they are much more effective (Campbell & Campbell-II, 2006; Fuhrman, 2005; McDougall & McDougall, 1995; Ornish, 2008; Paffenbarger & Olsen, 1996; Plant, 2007; Robbins, 2007). Then the next question is: but is this acceptable for most participants? And if we compare fast changers with slow changers, who is more happy and/or healthy afterwards? It turns out that fast and extensive changes are most attractive and most effective for most participants. The reason is twofold: 1) these changes bring fast results like weight loss and increased energy, thus enhancing motivation. 2) It creates a fast learning curve in the first week(s) and thereafter it becomes relatively easy to continue the adopted lifestyle, with much less risk of falling back into old behaviours (Ornish 2008, Fuhrman 2005, Campbell and Campbell-II 2006, McDougall and McDougall 1995). Moreover, those who progress most in the first week(s) have the best results in the long run (Fuhrman, 2005; Ornish et al., 1998). For a more extensive discussion on motivation and making large lifestyle changes see (Simons & Hampe, 2010).

Turning now to the question 2 from the list above: should interventions be broad or narrow? Again, the answer depends on the aim. Most studies focus on aspects in isolation, so they choose narrow interventions. However, if the aim is to maximise health outcomes, then broader interventions are likely to be more effective. That is, if the effects of the separate intervention components add up to a multi-factorial effect. Only very few clinical studies used broad line interventions, but (Ornish et al., 1990) has pioneered several studies combining factors as food, fitness, stress management and social support. Important to mention and strengthening the argument, his studies have included CVD, diabetes type 2, obesity and cancer patients. What Ornish has shown across CVD and prostate cancer is that 1) the larger the lifestyle change, the larger the medical effects, and 2) the factors have there own, independent contributions (Daubenmier et al. 2006, Ornish 2008, Ornish et al. 1990, Ornish et al. 2005, Ornish et al. 1998). In other words: apart from the fact that social support may be a motivating factor to support participants to eat healthier for example, there is also a direct contribution from social support to improved health outcomes.

Other studies suggest that there may sometimes even be positive interaction effects, in addition. This regards behavioural patterns, for example the combination of healthy food stimulating a drive to conduct physical exercise and vice versa. Furthermore it might regard to health outcomes, for example a body is metabolising food to fat more extensively when under stress (Kuo, Kitlinska, Tilan, Li, & al, 2007; Legendre & Harris, 2006), or smoking being more deadly when feeling alone or useless (Robbins, 2007).

As the final question 3 in this section we raise: Is primary or secondary prevention more effective for reversing age-related disease progress? One the one hand, 'normal' or primary prevention often had limited impact: people lack a sense of urgency and the health recommendations are often so moderate that they have limited impact. There is promise on the other hand, that with new e/mHealth applications additional motivational elements are introduced, for example fun, competition ('did I lose more weight than my peers last week?'), improvement feedback in daily activities or even game elements. Regarding secondary intervention, it has been found that patients' motivation to make big lifestyle improvements peaks around the diagnosis stage (Stull et al., 2007). About half the cancer patients, without being guided by their care givers to do so, make some form of lifestyle change (Richardson, Masse, Nanny, & Sanders, 2004). Given these observations, it appears that the health impacts of secondary prevention starting in the diagnosis stage could be much more significant if specialists would advocate them more actively to patients (Richardson et al., 2004).

Table 1: Questions and answers: Which interventions best reduce age-related disease progress?

1. Moderate versus extensive lifestyle interventions?	Extensive interventions are more motivating because they produce fast results. And the long-term health effects are larger.
2. Broad versus narrow interventions?	Broad interventions are scarce in literature, but produce most health improvements.
3. Primary versus secondary prevention interventions?	Traditional prevention has only had modest success. But e/mHealth may bring fun, competition or other game elements which stimulate health behaviours. Next, secondary prevention seems promising: patients' motivation to make big lifestyle improvements peaks around the diagnosis stage. And when specialists support health interventions, they can become quite effective.

3.2 What are promising contents and formats of interventions?

After having discussed which types of interventions hold promise, the next question arises: what to include in the design of interventions on a more detailed level? This is broken down into the two questions below. The answers are summarized in Table 2 at the end of the section:

1. What are suitable *contents* (e.g. food, exercise, supplements) of health interventions?
2. What are possible *formats* (e.g. revalidation plans or consumer games) of health interventions?

Instantiating the term *contents* of interventions (question 1), we propose at least the following factors: smoking, food, physical exercise, stress management and social support. Smoking is nowadays a well accepted risk factor and smoking cessation is our society's main success in reducing cancer deaths since the 1960's (Robbins, 2007). However, the other factors have more impact than most people realize. For example, some studies show that those patients on a wholefoods, low fat diet live on average 10

years longer (and healthier) than others (Fuhrman, 2005; Robbins, 2007). There are also large regional differences worldwide, or regionally within China for example, showing large differences (factor 5-10) in CVD, diabetes and cancer incidence, which correlate strongly with food patterns* (Campbell & Campbell-II, 2006; Fuhrman, 2005; Plant, 2007). Also regular exercise (Paffenbarger & Olsen, 1996), chronic stress and social support (Ornish 2008, Servan-Schreiber 2004, Servan-Schreiber 2008, Robbins 2007) can each make a difference in healthy life span of 5 – 10 years. One has to admit certain limitations of many of these studies, because they are unable to incorporate interaction effects caused by other factors,. On the other hand, several positive interaction effects are known (see section 3.1) where healthful behaviour in two domains creates more benefits than the mono-effect of the isolated factors. We conclude: health intervention programs should be broad and coach people towards healthier behavioural patterns on the following factors: foods and smoking, exercise, stress management and active use of social support sessions. .

The *formats* of health interventions can be diverse. Classic examples are the health guidelines provided by organizations like the American Heart Association. This format unfortunately has a history of providing 'diluted' health guidelines, which are less effective than more advanced health guidelines (Jopp & Arnold, 2008; Ornish, 2008; Willett & Skerrett, 2005). These 'diluted' guidelines follow partly from filtering 'is there 100% proof and will our audience accept this message' and partly via political embedding 'big changes create too big political effects'. This 'dilution' can be avoided in two other types of formats: the extensive interventions we discussed in section 3.1, and e/mHealth applications that stimulate people to go as far as they want towards the healthy end of the spectrum (Ornish, 2008). And it is not just patient motivation where e/mHealth holds promise, it also in the area of integral health management, as we discuss in section 3.3.

Table 2: Questions and answers: What are potential e/mHealth contributions to interventions?

1. What are suitable *contents* of health interventions?	For reducing disease, people should improve their habits regarding foods and smoking, fitness, stress management and social support.
2. What are suitable *formats* for health interventions?	A combination of targeted lifestyle intervention programs and e/mHealth consumer products (enjoyment, daily activities) appears most promising.

3.3 What could e/mHealth solutions contribute?– System Quality & Information Quality case illustrations

There are likely to be more ways in which e/mHealth solutions might contribute to health improvement interventions, but we focus on two important ways. These are

* Whole plant foods fight disease (via ten thousands of recently discovered fytochemicals) and processed and animal foods promote diseases of affluence (via animal proteins, fats, hormones, growth factors and refined sugars and oils, which promote for example chronic inflammation, excess growth, metabolic disorders, disruption of cell signaling pathways and DNA), as more extensively explained by others (Fuhrman 2005, Campbell 2007, Plant 2007, Ornish 2008).

related to the classic ‘system quality’ and ‘information quality’ concepts (W. DeLone & McLean, 1992; W. H. DeLone & McLean, 2003).

In the general Information Systems field, a review of the literature shows that definitions vary across authors (Bharosa, Zanten, Appelman, & Zuurmond, 2009). Still, ‘system quality’ aspects often mentioned are system flexibility, accessibility, integration (interoperability across organisations), efficiency and ease of use. Another review of various ‘information quality’ definitions allows to follow a schema with four overall aspects: intrinsic information quality like accuracy and objectivity, contextual quality like relevance, timeliness and completeness, representational quality like conciseness and ease of operation, and finally: accessibility (Lee, Strong, Kahn, & Wang, 2002).

System quality in the health domain relates to delivering integrated health (self-) management by and across stakeholders. This is what some early eHealth interventions, like the COACH case we will discuss below, have been focussing on for the past decade: creating a health management dashboard across stakeholders and integrating health care activities into an overall health management workflow.

Information quality in the health domain relates to (near-) continuous monitoring and guiding of health behaviours and outcomes. Interestingly, many new mHealth applications, like those running on the iPhone for example, seem to hold particular promise for raising health information quality (we elaborate on these applications later in more detail). By using mobile devices, health information is brought more closely into everyday activities. Furthermore timeliness and relevance can be improved, more accurate measurements of activities are possible, and accessibility of information is enhanced, just to mention a few aspects.

COACH case: tele-Coaching Patients On Achieving Cardiovascular Health

Our first case illustration is the COACH case. It is a distance coaching application created and developed since 1995 in Australia (Vale et al., 2003). It uses telephone for coaching, plus software for supporting coaching sessions, it allows for progress reporting to patients and physicians in charge, and integrates into the overall health management process. The primary aim is to empower patients to take better care of themselves. The first focus was CVD, later this was extended to diabetes type 2 and COPD. Health behaviours are promoted, as well as medication compliance. The patients are coached for 6 months. During those months they make their own ‘improvement plans’ to reach health behaviour targets. These plans and targets are entered into the system and then shared with the other stakeholders. Health behaviour targets are negotiated with the coach, based on an understanding of the desired health behaviours and on short term participant priorities. Research shows that participants do not only improve their health behaviour and outcomes during the 6 months, but also in a follow up period of four years thereafter: average weight and smoking continue to go down for example. As result, hospital utilisation in patients with coronary heart disease is reduced by up to 20% compared to standard care alone in the four years after the intervention.

Table 3: Health management System Quality in the COACH eHealth case

Integral health management (across care providers and patients)	For CVD patients this was one of the first programs for a relatively integral form of health management (although not a broad as the Ornish program). The main contribution is that patient self-management, specialist physician care and health coaching are integrated into an overall health plan and workflow.
System flexibility	The functionality and data used is relatively stable; when new medications, guidelines or patient subgroups have to be added, this can be planned in a straightforward matter.
Accessibility	The coach application is Web based, now used by 20 care provider organisations and is easily accessible. Because of the tele-coaching setup, sessions can be scheduled any time, any place.
Integration (interoperability)	The COACH program has aimed for functional integration, not technical integration. Data is sent to others via reporting, but there is no data integration. For new patients, data is entered from scratch.
Effectiveness, efficiency and ease of use	Apart from the efficiency for the coaches, the other care providers and patients find it efficient, because it efficiently adds value to their processes, but does not disturb them. As a big advantage to patients, sessions can be scheduled any time, any place and do not require travel time.

The COACH eHealth case provides an attractive example of some of the health management related System Quality improvements, which can be achieved through eHealth care concepts. Table 3 provides a summary. In a way, the technical System Quality appears to be mostly a hygiene factor for this case. The largest advantages stem from the fact that in terms of managing patient health (a) an integral workflow is created (b) this workflow is communicated and supported across the stakeholders via an efficient way of reporting, and (c) that traditional care processes are enhanced rather then hampered by the COACH program. An additional significant advantage for the patients holds property, that sessions can be scheduled any time, any place and do not require travel time.

iPhone Health Apps case: mHealth creating a 'portable health coach'

Apple's iPhone (and very likely the Android based smart-phones in the near future) has rapidly become a platform for an enormous range of portable health applications. For example, more than 2300 applications are available via (iPhoneHealthApps, 2010), a top 50 is created on (iFit_Top_50, 2009) and a top 100 on (iFit_Top_100, 2010).

Some of the main categories match well with the health intervention scope discussed in section 3.2: nutrition (tracking as well as applications for information on specific foods or diets: 'contains gluten'), exercise, health monitoring (e.g. blood glucose, heart rate) stress reduction (yoga or mediation exercises) or social support (inspirational quotes for example). So by combining a few of these applications the iPhone virtually turns into a

personal health monitor and coach. This offers a number of information quality advantages as shown in Table 4.

This is only part of the much larger range of technologies fostering new ways of bringing biometrics to the medical arena. The ongoing research in actor- / sensor-technologies, externally mounted to the body or implanted as well as the advances in body area networks and their connectivity to the internet will enrich the field of medical monitoring and control enormously. Combined with new prevention schemes we have to realise that currently any enthusiasm should be confronted with the risks, as yet neither well understood nor controllable. Privacy issues, safety and software stability as well as sufficient availability of a continuous power supply are just a few to be mentioned. As a consequence, besides early experiments we need to reach substantial milestones before broad acceptance from patients and care takers can be expected. Nonetheless from our understanding it needs the arguments we present in order to put challenges and opportunities into the right relation. The concepts of information quality and system quality are widely discussed in the IS literature and seem most appropriate to be transferred to the medical context, especially for studying e/mHealth approaches.

Table 4: mHealth that enhances health Information Quality in the iPhone Health Apps case

Accuracy & objectivity	Many iPhone Health applications use subjective inputs, so accuracy can be a concern. However, applications that use sensors (like the motion sensors in the iPhone) have a significantly more accurate view on the patient than the stand alone fitness bike in the sports club.
Relevance	An important advantage is that the applications can be selected based on their relevance. And because they connect to daily behaviours, they can be more relevant than a monthly health check.
Timeliness	Timeliness is a significant advantage of mHealth: information can be given of captured at the relevant time.
Completeness	There is a completeness advantage in the sense that 'time sampling' is much more complete (see timeliness). Whether the health monitoring and feedback is complete depends on the apps. Most apps now are relatively narrow and isolated. They do not offer a complete health picture.
Representation (concise and easy)	This varies per the application, although on average they are designed for conciseness and ease of use.
Accessibility	Accessibility is a significant advantage of mHealth: in principle any type of information, application or communication can be accessed whenever desired.

The COACH progam and iPhone application variety are only two examples; there are many others (think of initiatives from Google, Nintendo (DS and Wii), Nike+, Nokia, Philips, Microsoft). What we aimed to illustrate is that

- A more integral health management is possible compared to standard practise of today,

- e/mHealth types of dashboards and integrative applications can not only help patients integrate their information and care processes, but also stimulate taking ownership of health improvement,
- As a bonus a more integral health management system may be created providing communication interfaces to the various care providers involved,
- mHealth applications can support patients throughout the day, providing feedback, information and motivation, plus allowing data capturing that is useful for care providers,
- Thus, the quality of information used in the health management process can be enhanced,
- Care providers may actually use these 'consumer product' type of applications to enhance their plans for patient recovery after hospitalization for example.

For the future, we foresee at least two important challenges: Firstly, most health applications are currently running as isolated applications and, even when using Web services, made for stand-alone usage. Openness is an asset for future growth and health care provider integration. And secondly, many e/mHealth applications currently have a narrow focus, supporting only one or two of the health content aspects from section 3.2. To increase their usefulness, they need to be combined with other applications (which relates to openness again). We do not plead for the one and only application trying to cover all features. We rather suggest to concentrate further on standards for data interchange and the design of a long-term electronic personal health record. This discussion is existing since many years, but beyond the scope of this paper.

The main opportunity for the future is to make optimal use of the e/mHealth potential in our regular health care planning. Again, combining 'private' health activities with 'provider' care activities into an overall health improvement process seems very promising and logical, from the individual and from a societal perspective. Below we discuss briefly some aspects regarding the feasibility.

4 Discussion and Conclusion

The topic of integrating e/mHealth support into existing health care practices is of course extensive and complex and would merit separate analyses, like (Adigozel, Pellathy, & Singhal, 2009; Porter & Teisberg, 2004). Here, we will attempt only a high level check, via three questions:

1. Is there a fit with patient interests and desires?
2. Can we envision a fit with care provider interests?
3. Could there be a fit with the health care system (issues like funding, legislation, education, innovation priorities, division of tasks and responsibilities)?

Regarding question 1, asking for the fit with patient interests and desires, we see large diversity A significant subgroup of patients has been identified as interested in actively contributing to their health and fighting their disease. If they understand the health risks and opportunities, they are often motivated for drastic life style changes to make improvements. They are happy with well-researched health programs to support them.

Others are not. We propose to only aim for the first group, but at least to offer all of them these options, so allowing them to make an educated decision (at any time).

The next question is the fit with care provider interests. On the positive side, these health interventions help increase the motivation and success rates of specialists' patients. On the downside, many physicians are still unfamiliar with these interventions and might tend to underestimate the medical benefits (Richardson et al., 2004). Moreover, physicians are not trained nor reimbursed for health interventions. And if these interventions reduce the surgery or medication required, they may be forces to balance interests falling on ethical and financial scales. So in general there is a potential 'cannibalisation risk', which may require some 'reengineering of reimbursement schemes and doctor's fee structures'. The role of the above mentioned health coach has to be defined and introduced carefully, as they could be regarded as additional intermediaries between the medical specialists and the patients.

Finally, there is question of the fit with current Western health care systems. Despite the differences, they are similar in the sense that education and innovation in the sector seems to be largely driven by equipment manufacturers and pharmaceutical companies. Next, physicians' focus is more on treating illness and symptoms than primarily on improving prevention schemes. In consequence, insurance and reimbursement policies currently follow this focus†. But this may change in the future: due to ever rising costs there is a strong financial drive to better use of prevention options. Finally an opportunity and challenge, is the integration of e/mHealth approaches into care provider disease management programs. We expect a lot to happen here in the coming decade (cf. sections 3.1 to 3.3) with a possible front runner role of care centres, taking more of an integrator and health management position than they played in the past.

Overall, sophisticated, interoperable and well-integrated e/mHealth solutions could make healthy living more fun, create improved health results, upgrade patient recovery programs and may lead to even lower overall health care costs.

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† Interestingly enough, most insurance companies find it more normal to pay $ 100,000.- for bypass surgery than a much smaller amount for a health program that has an 80% chance of preventing the need for that surgery, as Ornish (2008) observes.

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