

# Use of Electronic Diaries within Treatment of Obesity and Binge Eating Disorder: First Experiences

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**Abstract:** After initial use for treatment-documentation within the scope of follow-up studies, electronic diaries are increasingly implemented in clinical settings. Particularly, diaries seem to fit very well in areas where "paper and pencil-diaries" yet constitute well established elements of symptom-focussed treatment settings, including a detailed description and analysis of problem behaviour. This e.g. applies to treatment of eating disorders like anorexia nervosa, bulimia nervosa or binge eating disorder (BED). BED is characterised by ingestion of a large amount of food in a discrete period of time, accompanied by a sense of loss of control.

BED in particular appears to be predisposed for the use of electronic diaries: By the mean of self-observation based on diary recording, information about triggers of problem behaviour, thoughts, somatic symptoms, and feelings experienced during a binge, as well as patient's reactions in a detailed manner may be assessed. Therefore, as a therapeutic mean, electronic diaries are fostering taking-over of self-responsibility and thus, will raise treatment motivation. Especially when binge eating and loss of control occur, the use of diaries enhances self-control and self-regulation.

Electronic diaries realised on handheld-computers (Palm 100m) are used within the scope of an intervention study realised by the Dept. of General Internal and Psychosomatic Medicine of the University of Heidelberg, focussing on treatment of obese patients with binge eating disorder. Purpose of the study is the registration of therapeutic relevant information as well as the assessment of progression within a multimodal, out-patient group therapy.

First experiences demonstrate the feasibility of mobile computing systems even with elder out-patients with no or little technical knowledge. However, implementation of the system requires focussing particularly on technical aspects. Limitations which may result from insertion of innovative technical equipment (particularly, a susceptibility to electronic problems and maybe resulting in restrictions of data) should be considered in an adequate manner during scheduling.

## 1 Background

Due to socio-economic changes over the last fifty years, overweight and obesity have become common conditions in western industrialized societies. Today, a substantially increased nutritional intake, combined with a decreased need for physical activity has led to about every second individual in these countries being overweight, with a substantial proportion being obese, as expressed by the body mass index (BMI). Following interna-

tional classifications recommended by the World Health Organization [Wor95], the body mass index is calculated by dividing weight (kg) by height (m) squared, thus defining "overweight" as having a body mass index of 25-29,9 kg/m<sup>2</sup> and "obesity" as having a body mass index of 30 kg/m<sup>2</sup> or greater. The prevalence of overweight is estimated to be about 55% among adults in the United States, one half of whom are considered obese [DYW00]. Prevalence rates in German surveys reveal similar conditions, with an estimated 50% of the population overweight, and approximately one sixth of the total population obese [Arb99, KIo00].

Overweight and obesity impact not only social well-being; excess weight is associated with a substantially greater risk of severe illness, making it a serious public health problem. An extensive body of literature has documented links between overweight and elevated mortality and morbidity due to diseases such as coronary heart disease and congestive heart failure, sleep apnea, diabetes mellitus, arteriosclerosis, stroke, orthopedic problems, gallstones, certain types of cancer, menstrual abnormalities, and impaired fertility [HS01, SK01]. Whereas overall mortality is only slightly higher among the overweight, it is markedly higher for obese individuals with a body mass index greater than 30 kg/m<sup>2</sup>, and particularly for those with severe obesity (BMI over 40 kg/m<sup>2</sup>) [Nat00, DYW00]. Diseases that develop as a consequence of obesity carry considerable societal costs, highlighting the economic impact of overweight and obesity. Not only are there increased health care costs at the individual level, but being overweight is also related to decreased job earnings and increased numbers of disability days. Estimates of the total cost of obesity in the United States, including direct and indirect costs, amount to nearly \$100 billion per year [WC98]. As early as 1995, in Germany, the estimated costs exceeded 10 billion Euro, equivalent to 5,4 percent of total disease-related costs [Arb99], and these costs have likely risen in recent years.

Despite rapidly increasing incidence rates of overweight, adverse attitudes towards obesity remain and are combined with unrealistically underweight ideals of physical attractiveness and fitness. As a consequence, eating disorders are quite frequent in the general population. In short, there are three main eating disorders that can be identified and differentiated by body mass index:

**Anorexia Nervosa** is characterized by individuals being severely underweight due to insufficient nutritional intake. This is based on a fear of gaining weight and body shape disturbances, resulting in a body mass index lower than 17,5 kg/m<sup>2</sup>.

**Bulimia Nervosa**, first defined by Russell in 1979, can be characterized as a "hidden" disease. Bulimic individuals engage in repeated eating attacks, combined with regular compensatory behaviors. In contrast to anorexic patients, they are usually of normal weight, with a body mass index between 19 and 30 kg/m<sup>2</sup>.

**Binge Eating Disorder (BED)** is characterized by the consumption of large amounts of food over short periods of time, indicating an underlying loss of control. This behavior usually leads to an elevated body mass index and often considerable obesity or overweight. This disorder is the most recent to be identified and was only added to the Diagnostic and Statistical Manual of Mental Diseases (DSM-IV [Ame94]), the international classification of the American Psychiatric Association (APA), in

1994. Particularly over the last decade, an increasing number of studies on BED have been conducted [DBF02].

In more detail, BED, following proposed DSM-IV research criteria, can be characterized as follows:

1. Recurrent episodes of binge eating, characterized by:
  - Eating a large amount of food in a discrete period of time (e.g. two hours).
  - A sense of loss of control while eating.
2. Binge eating episodes are associated with at least three of the following characteristics, as behavioral indicators of loss of control:
  - Eating much more rapidly than usual.
  - Eating until feeling uncomfortably full.
  - Eating large amounts of food although not feeling physically hungry.
  - Eating alone to conceal eating behavior.
  - Occurrence of negative emotions, e.g. guilt, disgust, depression.
3. Individuals feel markedly distressed because of binge eating.
4. Binge eating behavior occurs at least two times a week for a period of six months.
5. Individuals do not regularly engage in compensatory behaviors such as purging, misuse of laxatives or diuretics, or excessive exercise.

Though itself not a condition, obesity usually accompanies Binge Eating Disorder and there seems to be a positive correlation between binge eating severity and the degree of obesity [DBF02]. In contrast, there is no evidence that binge eating in obese patients has to be considered as a result of dietary restraint, as is the case with bulimia nervosa [GM00, Zwa01, MG02]. In about half of all individuals, dietary restraint follows bingeing and does not constitute the preceding condition.

The prevalence of binge eating disorder ranges from 2-5 % in community samples, but is as high as 30% in samples consisting of participants in weight control programs, making it a considerably important disease within this group of patients [ZLH00, HS01]. As a consequence, specific treatment settings have to be designed, with a particular focus on normalizing eating patterns and malnutrition related with overweight, while at the same time considering the with elevated psychopathology associated with co-morbid existing binge eating disorder.

Following their initial use for treatment documentation within the scope of follow-up studies [KMM01], electronic patient diaries (EPD) are increasingly being implemented in clinical settings [ABB00, BRZ01]. While overall, traditional paper-and-pencil-diary use is a well-established element of symptom-focussed treatment settings, such as for chronic pain diseases, depression or anxiety disorders, EPD seem to fit particularly well to the treatment of Binge Eating Disorder.

The general use of diaries is recommended for a variety of reasons [SM96]: Precise description and analysis of problematic behavior is of central importance within clinical settings, which focus on symptom treatments. Diaries can be used in natural settings, thus preventing data from being influenced by artificial conditions. Diaries also allow (systematic) registration of cognitions and feelings, which are not always directly accessible to the therapist. Finally, because of direct and systematic registration of behavior, bias due to retrospective judgments is prevented. A detailed analysis of problematic behavior is facilitated by the systematic registration of triggers of problematic behavior, of thoughts and feelings as part of the not directly observable inner processes, of somatic symptoms, of individual reactions, and finally of situational characteristics, particularly when binge eating occurs.

As a consequence, the use of diaries promotes self-awareness, thus increasing self-control and self-regulation capacities. In turn, increased capacity for control may foster a sense of self-responsibility, and thus enhance patient motivation and readiness for change.

Electronic diaries have a number of advantages over traditional paper-and-pencil diaries (especially in terms of standardization, data structure, data transfer, and analysis). In sharp contrast to common applications of diaries within Binge Eating Disorder treatment settings (as well as within treatment of eating disorders in general), only one study exists documenting the use of electronic diaries in this field. Greeno [GWS00] reported the use of handheld computers to measure mood, appetite and setting at all eating episodes in a sample of women with and without binge eating disorder, to investigate specific binge antecedents and possible distinctions between the two groups.

In a study currently being conducted by the Department of General Internal and Psychosomatic Medicine of the University of Heidelberg, handheld computers (Palm m100) are being used as electronic patient diaries in a multimodal outpatient treatment setting for patients with obesity and Binge Eating Disorder. In addition to the advantages described earlier, the use of electronic diaries specifically targets the registration of therapeutic relevant information (behavioral diagnostic) during the course of intervention, as well as the assessment of interventional progress and treatment outcome. Throughout the 4-month treatment period, the computer daily sounds an alarm signal reminding patients to complete data assessment. In this way, data on weight, general eating patterns, eating patterns related to binge episodes, and general and specific mood characteristics are obtained regularly throughout the course of intervention. Data are downloaded via docking station and saved once a week, as patients arrive for treatment. Frequent registration and the possibility of graphic analysis allow direct feed-back to the patient in case major irregularities occur. For more sophisticated analyses, this type of data acquisition allows further time series analysis, which is designed to identify possible relationships between symptoms and documented characteristics. In addition, variables that might predict specific progress, as well as short and intermediate term treatment outcomes, can be monitored and investigated.

## 2 Summarizing Experiences

Initial experiences with handheld computers used as electronic patient diaries demonstrated quite a series of advantages. Difficulties related to this new technology, however, also arose, and are analyzed and evaluated below.

Experiences with manageability and applicability of electronic diaries were quite good. Despite the relatively high mean age of our patients (>40 years) and their limited computer experience, preliminary results showed high feasibility scores with our mobile computing system (Palm m100). An oral introduction of about one hour, combined with an instructional hand-out appeared to provide sufficient information for daily use of the diary. Acceptance of the instrument was also high. Although a considerable number of participants in our study had little or no technical knowledge, reluctance to diary use was quite low. In only a few isolated cases was there unwillingness to use the diary, and this was most likely a response to the questions being asked, and not to the diary itself. No patient overtly rejected use of the diary. Although the application period of the diary in total was quite long (about 4 months), patient compliance was particularly high throughout the intervention, and missing data did not arise as a major, systematic problem during the intervention.

In terms of data collection, the main advantages of electronic patient diary use can be summarized as follows:

First, data collected are structured and standardized on an intra- as well as an interindividual level from the beginning, allowing the use of certain question types (e.g. visual analogue scales). This is useful for measuring, for example, subjective levels of mood without loss of data quality, facilitating an immediate interpretation and comparison data. Furthermore, data are collected in a continuous way. Because the electronic data are entered daily, the time necessary to obtain a data read-out is very little, thus ensuring only minimal expenditure of time and human resources.

Due to continuous data collection, sophisticated statistical analysis, such as time series, can be conducted. This allows identification of variables related to process and change within treatment, as well as variables that might predict progress and outcome. Finally, the continuous database allows the display of the actual state and general course of illness on an intra - as well as an interindividual level, whenever there is a specific need for verification.

The technical aspects of electronic patient diaries should also be evaluated critically and potential costs of the medium should also be mentioned:

From a technical point of view, the primary goal of our intervention program was the development of a working software-prototype to show the technical suitability of Personal Digital Assistants (PDA) for this scenario. For this reason, Java 2 Micro Edition (J2ME) was chosen as a platform for software development, and first experiences were gathered with the real use of EPD in the hands of patients.

In our view, the development platform J2ME offered two benefits: a familiar Java-environment and the general possibility of a platform independent development, although limited



Figure 1: Screen shots of the Binge-Eating-Prototype

thus far by the small number of supported systems. The J2ME with the Connected Limited Device Configuration (CLDC) proved to be a good choice for working with PDAs of type Palm m100.

Nevertheless, due to hardware- and software-environments that differ greatly from desktop-systems, and the still ongoing evolution of the J2ME product (together with a lack of available documentation and work experience), much time was needed for the prototype's development. Further projects will be less limited by this time factor.

While EPD use has many advantages, it is not without problems. Below is a summary of our experiences with the difficulties of EPD.

Although our patients demonstrated good capability in working with the PDA, two problems were highlighted:

1. Size, resolution and contrast of the display is limited and made the EPD's use difficult for people with poor vision. Though to date this problem has not affected use of diaries in our intervention, it could be a concern among samples where optic problems are more frequent.
2. Input with the stylus requires a certain amount of dexterity, in order to avoid misunderstandings or imprecise "clicks". This may also limit the applicability of Electronic Diaries in samples where motor limitations exist.

Data storage and data safety are two additional potential problems. Like most PDA, the Palm m100 does not contain a permanent memory, making regular battery checks (and regular data-backup) necessary in order to prevent unintentional loss of data. To avoid data-loss, such checks should be planned before using the PDA in a study, and conducted either by a well-instructed patient or included in the routine of data transmission in the clinical setting.

Despite the fact that EPD do not require extensive processor or memory capabilities, we found that this aspect should be considered both during software development and when considering the amount of data to be stored during a study.

Finally, the development of a technical prototype within a clinical treatment setting might present difficulties of "translation" between different professional groups.

This is illustrated by software instructional manuals, which are written by IT-professionals, but are often incomprehensible to health professionals. This lack of user-friendly documentation can increase the difficulties faced by health professionals who are trying to manage an unfamiliar system of electronic mobile devices while simultaneously being confronted with the technical challenges arising from data transfer to a single central PC.

Further technical development will concentrate on three aspects:

- Replacing the prototype with a new program, according to standard software-development guidelines, while taking into account the overall experience with the prototype,
- Using the Mobile Device Profile (MIDP) of the J2ME, rather than the CLDC, and
- working on a new version of EPD that can be customized for different scenarios, such as an Eating-Diary or a Pain-Diary.

### 3 Conclusions

Electronic patient diaries (EPD) undoubtedly provide users with a series of advantages concerning data collection and quality that allows new and sophisticated statistical data analysis. Actual clinical experiences also sustain applicability of these technical systems to older patient samples. EPD help patients to understand and reflect on their own pathological behaviors.

Nevertheless, a balanced approach to EPD requires a thorough consideration of the above-mentioned input needs regarding time, monetary costs and human resources, from development of specific tools to their implementation in the different clinical settings. Our preliminary experiences demonstrated a continuous need for technical support in terms of maintenance of diaries and database. It is important not to underestimate this need for support. In addition, data safety and quality might be compromised if they are not considered in planning from the very beginning. Finally, human shortcomings are neither predictable nor preventable. Often times, only improvisation can help in guiding one through the maze of ever-growing technical difficulties arising from the use of electronic systems in a clinical treatment setting.

In general, we highly recommend development and use of the electronic diaries in cases where continuous data collection is required. Electronic patient diaries are not economically advantageous, however, if needed for single or very short term use only. In the latter case, traditional paper-and-pencil-questionnaires and -diaries should be considered as a first choice.

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