Chapter 17

Enuresis

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OVERVIEW OF DISORDER

Diagnostic Criteria

Enuresis is the medical term that refers to the involuntary discharge of urine. Although this is the literal meaning of the word, many clinicians erroneously use the term to refer to urinary incontinence that occurs during sleep (nocturnal enuresis). Primary enuresis refers to urinary incontinence from birth and secondary enuresis, refers to urinary incontinence that develops after the child has been dry for at least 6 months. Diurnal enuresis refers to urinary incontinence that occurs during the day and mixed enuresis refers to urinary incontinence that occurs during the day and night. Monosymptomatic enuresis refers to nocturnal enuresis that occurs without any other symptoms. Polysymptomatic nocturnal enuresis refers to nocturnal incontinence that occurs in association with urinary urgency, the sensation that one must urinate immediately, urge incontinence, voiding due to the presence of an urge to void, or staccato voiding bursts of voiding.

The process by which our bodies’ physiological maturation interacts with daily psychological events as exemplified in our learning to gain control over urinating, is complex and rife with opportunity for learning to go wrong. It involves the establishment of a complex communication between our voluntary and involuntary nervous systems and our bladder and its surrounding pelvic floor muscles. The bladder is very elastic and is comprised of smooth muscle fibers that permit its expansion. Silverstein (2004) noted that:

“Filling of the bladder is achieved by a complex interaction between the sympathetic and parasympathetic nervous systems and the bladder musculature. Briefly, sympathetic (originating from T11 to L2 of the spinal cord) stimulation of beta adrenergic receptors in the bladder body, or the detrusor muscle induces bladder relaxation, allowing for filling. Filling is also achieved by contraction of the bladder neck (internal sphincter) smooth muscle fibers, under sympathetic control, and the striated muscle fibers of the

external sphincter, the latter under voluntary control. In contrast, bladder emptying is controlled by parasympathetic, or somatic control, from S2 to S4. Parasympathetic receptor sites are located throughout the detrussor muscle and the proximal urethra. When these receptors are activated, the detrussor muscle contracts, increasing intravesical pressure” (p.218).

In newborns urination is a spinal cord reflex. During the first or second year of life, bladder capacity increases as well as simultaneous maturation of the central nervous system resulting in a greater awareness of bladder filling but still an inability to voluntarily control voiding. Voluntary control of voiding is eventually achieved by the coordinated development of: (a) increased bladder capacity, (b) voluntary control over the external sphincter, and (c) central nervous system control over voiding or inhibition of micturition independent of bladder capacity. (MacKieth, 1972).

As we have observed elsewhere,

“Acquisition of urinary continence is a complex physiological process (Muellner, 1951; Vincent, 1974). Normal continence is attained through appropriate voluntary elimination via sphincter release upon the lowering of the bladder neck when it is full and preventing micturation by contraction of pelvic floor muscles which raises the top of the bladder.

Continence involves an appropriate bladder capacity, and the development of stimulus control of a full bladder over prevention of micturation until an appropriate situation for urination is present. This involves becoming aware of the need to urinate to avoid the emergency condition of “urgency” when urination is eminent, as well as the inhibition of urination while awake or sleeping. Incontinence can result from physical anomalies, neurological anomalies, and the lack of training oneself to recognize full bladder stimulation and act upon it” (Williams, Jackson & Friman, 2007, p.178).

Considered for some time to be primarily a sleep disorder, (Wolfish, Pivik, & Busby, 1997) recent research (Nevéus, 2003) indicates that the sleep of enuretic children is quite normal polysomnographically, but it is also very “deep”: Children with enuresis have high arousal thresholds.

Clinical treatment and research into childhood enuresis has revealed a variety of possible contributors including faulty suppression of urine production by the kidneys to the bladder during sleep ( Muelner,1951), malfunction or lack of maturation of the bladder, detrusor, and pelvic floor muscles responsible for adjusting the bladder position as it fills and empties,(Muelner, 1960), neurological signaling between the cortex and the musculature controlling the bladder and the bladder, especially during sleep, (Yeung, Diao, & Sreedhar,2008), anatomical irregularity or immature growth of the bladder resulting in small bladder capacity (Kawauchi et al.,2003), an unsuccessful development of operant or classical conditioning control over awakening in time to void appropriately or to not void until awakening (Gaber El-Anany, Maghraby, El-Din, Shaker & Abdel-Moneim,1999), and either infections anywhere in the urinary tract or a significant number of rare anatomical and physiological anomalies that result in the label of mixed enuresis and which require specific medical interventions. Treatments for nocturnal enuresis have closely followed these general known causes for primary and secondary nocturnal and diurnal enuresis and can be categorized generally as pharmacological, behavioral and other. Interventions specific to the variety of medical conditions that are associated with mixed enuresis will not be discussed.

Demographic Variables

If one parent is enuretic then enuresis occurs in children with a 40% increase from the general population and with a 70% increase if both parents are enuretic (Bakwin, 1993). By 5 years of age, 85% of children have complete diurnal and nocturnal control of urination. The remaining 15% of children gain urinary continence at a rate of approximately 15% per year. By 12 to 13 years of age between 2% and 5% of children will continue to have urinary incontinence or primarily nocturnal enuresis. The incidence of primary nocturnal enuresis adults has been reported to range between approximately 1.5% and 3%. Secondary enuresis occurs in approximately 3% to 8% of children between the ages of 5 and 13 years, and spontaneously resolves at approximately the same rate as primary enuresis (Husman, 1996).

Impact of the Disorder

Estimated to affect 5 to 7 million children in North America, primary nocturnal enuresis is three times more prevalent than day time wetting and occurs three times more often in boys. Secondary causes account for less than 25% of cases (Ramakrishnan, 2008); however, treatment efficacy is greatly dependent upon proper ruling out of multiple symptoms (Butler & Heron 2006). Indeed, Van de Walle, andVan Laecke, (2008) have noted the inconsistent reporting of actual participant admission symptoms due to differences in symptoms reported in the *Diagnostic and Statistical Manual of the American Psychiatric Association* (American Psychiatric Association, 1994) and the terminology outlined in the International Children’s Continence Society (Nevéus et al., 2006). This has resulted in a general lack of clarity as to the relative effects of different treatments on different sub populations of persons with enuresis. This observation limits all past and current research finding and conclusions and can only be addressed in future research with standardized reporting of a variety of participant symptoms or lack thereof in all research. It is increasingly being shown that different subgroups of monosymptomatic enuresis may benefit more from different treatments that have been developed for specific patient characteristics and studies should describe those characteristics to arrive at meaningful conclusions regarding the different forms and treatments of enuresis. This review then will also suffer from these limitations.

PHARMACOLOGICAL INTERVENTIONS

Imipramine

 Imipramine is a tricyclic antidepressant with anticholinergic effects which can affect nocturnal enuresis by reducing muscle tone of the bladder and by lowering arousal levels of deep sleep, especially in the later third of night time sleeping. Functionally, imipramine increases bladder capacity and assists in arousing the patient. Unfortunately, the effects of imipramine are closely tied to serum levels and the effective dosage to achieve an effective serum level has been shown to vary as much as 700% from one person to another (Fritz, Rockney, &Yeung, 1994). Additionally, some have reported negative side effects, such as upset stomach, and potentially fatal cardiac arrhythmias can be produced by higher dosages of imipramine (Husmann, 1996).

 Less than 2 wet nights per month have been reported with imipramine for 20-36% of patients, but cure rate is the same as for no treatment when medication is stopped (Kardash, Hillman, & Werry, 1968; Kunin, Limbert, Platzker, & McGinley, 1970; Martin, 1971, Monda & Husmann,1995). Most recently Nevéus & Tullus (2008) reported on a trial of imipramine compared to placebo and tolterodine. Although better than placebo, tolterodine was not as effective as imipramine which resulted in a mean of only 7.8 +/- 5.1 wet nights in a 2 week period with 25 children.

Imipramine is not reliably effective at eliminating monosymptomatic nocturnal enuresis and is the same as placebo for curing enuresis once medication is stopped. Reports of some side effects and the danger of over consumption causing heart disrythmia reduce its attractiveness as a treatment.

Desmopressin

Desmopressin is an analogue of the natural pituitary hormone vasopressin acetate which is responsible for reducing urinary production while we sleep and is believed to be at fault in many monosyptomatic noctural enuresis cases (Rittig, Walle,Yeung, & Djurhuus, 1989). Desmopressin produces an antidiuretic effect resulting in more reabsorption of water from the kidney, more concentrated volume of urine entering the bladder, and overall lower urine production. Its effects are only observed as long as the medication is taken.

Snajderova et al. (2001) reported on the use of desmopressin as a long-term treatment for 55 children with primary nocturnal enuresis. Intra-nasal desmopressin was administered in progressively higher doses (7-21μg) until bedwetting stopped in 89.1% of participants. Every 3 months, the drug was weaned and, if relapse occurred, the previous successful dose was reinstated. At the end of each of the 3 months, the number of responders remained higher (72.7%, 70.9%, 61.6%) than the spontaneous cure rate of 15%. Tulhis, Fosdal, EWinnergrad and Hjalmas (1999) found similar results in an open study of 300 children in Sweeden. Wolfish, Barkin, Gorodzinsky and Schwarz, (2002) reported on the 12 month effects of oral desmopressin on a group of 256 children from Canada. They found that 49 % showed an effect of greater than 50% reduction in wet nights from baseline.

*Meta-analyses of Group Designs*

Glazener and Evans (2002) reported a meta-analysis of 16 random control trials. The meta-analysis found that nasal desmopressin was better than placebo in reducing the number of wet nights per week (mean 1.34 fewer wet nights/week; 95% confidence interval, 1.11-1.57). Desmopressin at doses of 20 ug, 40 *ug,* and 60 *ug* similarly increased the likelihood of a cure defined as 14 consecutive dry nights during treatment in 3 trials reporting this outcome (relative risk for failure to achieve 14 dry nights with 20 ug = 0.84; NNT for cure = 5.6). Unfortunately, no difference was found in cure rates after treatment was stopped.

The benefits of desmopressin are temporary, with a high relapse rate once treatment is discontinued (Diehr, 2003). Desmopressin is most effective in children with nocturnal polyuria and normal bladder capacity. Desmopressin may be functional for temporary reduction in symptoms for purposes of sleepovers or camping etc.

Oxybutinin

Anticholinergics such as oxybutynin decrease detrusor muscle tone, frequency, and urgency of urination and increase bladder capacity. Oxybutinin has been used in children with primary nocturnal enuresis and daytime wetting showing restricted bladder capacity caused by an overactive detrusor muscle. It is also used in patients who have not responded to desmopressin.

Lovering, Tallett, and McKendry (1988) and Marconi, Felici Roggia, and Torelli, (1985) are two poorly designed random control trials of oxybutinin with large dropout rates such that no sound conclusions could be reached regarding effective treatment. Adverse side effects included dry mouth, blurred vision, headache, nausea, dizziness, gastrointestinal upset, and tachycardia (Glazener, Evans, & Peto, 2003)

Summary of Pharmacological Treatments

The research evidence for the effects of Imipramine and Desmopressin meets acceptable criteria for evidence based practice and provides support for these treatments as short term control over enuresis. However this same literature provides evidence that these interventions are not at all effective once medication is stopped, and therefore evidence for their non use in the long term treatment of enuresis. There is also support for the ineffectiveness of anticholinergics such as Oxybutinin in the long term treatment of enuresis, and appropriately controlled randomized control studies have yet to be conducted.

BEHAVIORAL INTERVENTIONS

 Behavioral treatments teach the skills necessary for continence as well as attempts to reduce or stop incidents of wetting. In contrast to drug and other treatments, the effects of behavioral treatments are often continue long after treatment has been terminated, although rates of relapse will be discussed later. Behavioral approaches to diurnal and nocturnal enuresis often involve many of the same treatment components or variations of these. Evidence for one approach is often evaluated as a component of treatment. So for this reason, each of these treatments, or components will be described more generally before the evidence for the effectiveness is examined and discussed with respect to diurnal or nocturnal enuresis. Variations of each treatment or component and the effectiveness of such variations will also be addressed.

Common Behavioral Interventions

*Urine Alarm*

The urine alarm (bell and pad apparatus) is probably the most well known and most researched treatment for enuresis. Mowrer first examined it in 1938, and since then studies of its effectiveness have lead to the identification of strengths and weaknesses of this technique in the treatment of enuresis. Variations in implementation have been developed to allow it to be used in a variety of different settings, with a variety of different individuals, and to enhance its effectiveness. In general, the urine alarm consists of a moisture sensitive switch that closes, setting off the alarm, in the presence of moisture (i.e. urine). For nocturnal enuresis, the moisture sensor is often placed inside the child’s pajamas or under the bed sheets and is activated when the child urinates. In cases of diurnal enuresis the child usually wears the device inside of his or her underwear. The development of a silent but vibrating alarm has also allowed the alarm to be utilized for cases of diurnal enuresis without the public embarrassment of an audible alarm (Ruckstuhl, 2003). *Retention Control Training*

 Many studies have shown a correlation between enuresis and a reduced functional bladder capacity (De Wachter et al., 2002). For example, Hallman (1950) assessed the bladder capacity of 192 children by giving them a large amount of water and then instructing them to refrain from voiding for as long as possible. Their urine outputs were then measured over the next 4-6 hours and the largest void was used as a measure of functional bladder capacity. This original finding was then confirmed by subsequent studies (Esperanca & Gerrard, 1969; Starfield, 1967), and has been shown to be true both diurnally and nocturnally (Troup & Hodgson, 1971).

 These findings have led to a treatment approach that involves requiring individuals to drink more fluids and then delay urination for an increasingly longer time to remediate the disparate functional bladder capacities of enuretic individuals, but does not directly train skills that may be associated with nocturnal continence. This approach assumes that the correlation between enuresis and functional bladder capacity is causal, meaning that continence problems are seen as a direct result of a smaller functional bladder capacity. *Positive Practice*

 Positive practice has been a common element of treatment in both diurnal and nocturnal enuresis. It involves the repeated practice of going to the bathroom and sitting on the toilet numerous times, in the absence of the urge to urinate. In the case of diurnal enuresis this is often conducted many times throughout the day and the child is required to interrupt ongoing activities to go to the bathroom a specified number of times. In the case of nocturnal enuresis the child is required to lie in bed for a specified period of time and then get up out of bed, go to the bathroom and sit on the toilet. This is often done during waking hours before going to bed and is practiced repeatedly in a given time period. Such practices may also be implemented contingent on an incident of wetting behavior. When the child has an accident they are required to repeat the practice of going to the bathroom and sitting on the toilet.

 When an accident has occurred, positive practice is often combined with procedures that involve the restitution of the surrounding environment. This means that the child is required to change clothes or pajamas, clean themselves, clean up the area where urination occurred, for example, remove bedding and replace with clean bedding, and perhaps even do laundry that includes bedding or clothing that contacted urine. These procedures have also been referred to as “Responsibility Training” (Friman & Jones, 1998) and “Cleanliness Training” (Azrin, Sneed, & Foxx, 1974).

*Stream Interruption Exercises*

 Stream interruption exercises consist of practice in the initiation and then termination of urine flow during a urinary episode. This approach is derived from the treatment of incontinence in women where they are required to contract and relax Kegel muscles in the pelvic floor. As these are the same muscles utilized to stop the flow of urine, this approach seems to be relevant to the treatment of enuresis and is often included as part of a treatment package for enuresis (Friman & Jones, 1998).

*Waking Schedule*

 Waking schedules are only applicable to the treatment of nocturnal enuresis and typically involve waking the child at some predetermined interval and guiding them to the bathroom (Azrin et al., 1974). The initial interval until waking may be based on the typical period from the onset of sleep until an incident of wetting occurs. Waking may occur throughout the night, for example, every hour, or may just occur at the critical time before wetting. These awakenings are then systematically faded out by awakening the child progressively less or earlier in the evening until they can go to the bathroom before bed and stay dry until morning. This fading is typically based on a criterion of dry nights.

*Positive Reinforcement*

 A number of procedures based on the principle of reinforcement have been utilized in the treatment of enuresis often used in conjunction with other approaches. Positive reinforcement is often viewed not as a method by which to cure enuresis, but a way to increase or maintain participation. Children are often allowed to select items that they would like to earn. Then conditioned reinforcers, such as tokens, points, stars, etc., are delivered for appropriate continence related behaviors and later exchanged for the larger, significant preferred item or activity selected by the child (Friman & Jones, 1998; Harris & Purohit, 1997; Lassen & Fluet, 1979; Paschalis, Kimmel & Kimmel, 1972; Popler, 1976). Other reinforcement-based procedures have delivered preferred items such as food, toys, or activities directly following appropriate voiding or other continence related behaviors (LeBlanc, Carr, Crossett, Bennett, & Detweiler, 2005; Samaan, 1972). Reinforcement procedures have been utilized in the treatment of both diurnal and nocturnal enuresis.

*Dry Bed Training*

 A combination of many of the above mentioned treatments was first utilized by Azrin, Sneed, and Fox, (1974). Their treatment package included increased fluid intake, scheduled awakenings and reduced intensity of prompts to waken, positive practice, reinforcement of appropriate voiding, use of the urine alarm, wetness awareness,(some children need training in discriminating that they have wet underwear or wet bed sheets) and cleanliness or responsibility training.

 Evidence For Effectiveness of the Urine Alarm

Mowrer (1938) first reported the use of the urine alarm for the treatment of enuresis and since then, many other studies have examined the effectives and the underlying mechanisms responsible. Although the alarm has primarily been used for the treatment of nocturnal enuresis, there is also evidence for its effectiveness in treating diurnal enuresis and these will be discussed separately. There is a literature on the potential learning processes that may underlie the effectivenss of the urine alarm. Early work emphasized possible classical conditioning (Lovibond, 1963, 1964), whereas later work emphasized operant mechanisms (Azrin, et al., 1974; Hansen, 1979; Mace & Parrish, 1984; Turmer, Young & Rachman, 1970). The reader is referred to these sources for a more detailed discussion of this question.

*Diurnal Enuresis: Single Subject Research*

Friman and Vollmer (1995) used a urine alarm to treat the diurnal enuresis of a 15year old female. Treatment resulted in arrest of accidents almost immediately and the authors suggest that the underlying mechanism was negative reinforcement, specifically avoidance of the embarrassment of the alarm signal in public. This treatment was examined using a reversal design and, although accidents increased again with the withdrawal of the treatment, they did not return to baseline levels. Reduction of accidents to near zero levels was achieved after only two learning trials and the effects were maintained at a 3 and 6 month follow-up. Caution should be used in considering the use of such a treatment for diurnal enuresis, as the child may suffer further negative effects of the embarrassment of the alarm such as social withdrawal, anxiety etc. and may attempt to remove the alarm and interfere with treatment. One way to avoid this issue is to use a silent vibrating version of the alarm, which was evaluated for effectiveness in treating nocturnal enuresis and found to be effective in arresting accidents in almost half of the participants (Ruckstuhl, 2003); however, if avoiding embarrassment was the key consequence in this intervention, then this may results in ineffective treatment.

*Diurnal Enuresis: Group Designs*

Fielding (1980) examined the effects of urine alarms on 45 children with nocturnal enuresis and 30 children with both diurnal and nocturnal enuresis. In this section attention will be drawn to the effects of alarm treatment on the daytime wetting of the day and night participants. Individuals from both categories were divided into two treatment groups with one group being exposed to the urine alarm immediately after baseline and the other group being exposed to retention control training (RCT), for the first four weeks and then, if continence was not achieved, they were exposed to the alarm treatment. Although the alarm was only used at night, effects on both day and night wetting were measured. The criterion for success was 14 consecutive dry days or nights and failure to attain this criterion was decided after 14 weeks of treatment.

Despite some slight reductions in the day wetting frequencies under both treatment regimes, neither treatment showed a significant effect during the first four weeks of treatment. A comparison of baseline daytime wetting frequencies with frequencies of wetting in the first four weeks of treatment, failed to reach statistical significance for either groups (RCT: t = 0.973 df = 6; alarm, t = 0.17 df = 6). Over subsequent months of alarm only treatment for both groups, there was a gradual reduction in the frequency of day wetting under both treatment regimes; however, comparisons of the frequencies of day wetting in baseline to those of the first, second and third month of alarm treatment failed to reach statistical significance. Of the 17 children in the day and night wetting group who completed the study with a full data set, 8 achieved the success criterion during the day, with 4 of these 8 also achieving dryness at night. Four of these eight participants were in the RCT then the alarm group and four were in the alarm only group. In general the response of day wetting to the alarm treatment was varied with success being achieved for some participants and not for others. The source of this variation was unknown. In addition, of the 8 participants who met the success criterion, 66% had relapsed at 3 and 6 month follow-up, with relapse defined as 2 instances of wetting. Moreover, children with both day and night wetting relapsed earlier than the children who only experienced night wetting and that there were a greater number of drop outs from day and night wetting participants.

*Noctural Enuresis: Single Subject Research*

Hansen (1979) provided a variation on the standard urine alarm by using a twin-signal device that allowed escape and avoidance conditioning. This procedure involved one alarm that went off after urination on the pad, and then stopped. If the child did not awaken, get up, and turn off the alarm system, the second alarm would sound and did not stop until turned off. This procedure was explained to the child before the treatment began. When awakened by the first alarm they were required not only to get up to turn it off but also go to the bathroom and finish urinating, change pajamas, and the parents changed bedding and pad, and reset the alarm. This device was utilized with two children aged 8 and 9 years and was successful in arresting the nocturnal enuresis of both participants over a treatment period of 200 days. Furthermore, these effects were shown to have maintained at a 1year follow up.

 Samaan (1972) reported the failure of urine alarm procedures to treat the nocturnal enuresis of one individual. A 7year old child described s a “slow learner” (p. 103) with primary enuresis participated. His parents were trained to use the traditional pad and bell alarm treatment and to report their results daily. After two weeks of intermittent success, a waking schedule and a reinforcement-based procedure were introduced as treatment, and then gradually faded. This led to zero levels of bed-wetting and maintenance of these effects at a 2-year follow up. Although the author reported the failure of alarm procedures for this case of nocturnal enuresis, it should be noted that this treatment was only in effect for 2 weeks and that many other studies have assessed the effectiveness of treatment procedures over much longer periods of time (Young & Turner, 1965; DeLeon & Mandell 1966).

*Single Subject Package Treatments*

LeBlanc, et al. (2005), demonstrated effective treatment for two of the three participants in their study who were diagnosed with autism and had not yet been effectively toilet trained despite numerous attempts by parents. Treatment involved many components in addition to the urine alarm including a sitting schedule, reinforcement contingencies for successful voids and self-initiations, increased fluid intake, communication training, and positive practice for accidents. The criteria for success in this study was no accidents for 2 consecutive days with at least one self-initiated void in the toilet, or 80% success for 2 consecutive days with at least 40% of successful voids being self-initiated. For the two participants who met this criteria they remained continent at a four week follow up.Mace and Parrish (1984) in a staggered multiple case study intervention demonstrated the complete elimination of nocturnal enuresis in two brothers, by treating one sibling who was deaf and explaining to the other sibling that they could avoid treatment with the urine alarm if they had 14 consecutive dry nights. Given that one child was unable to hear the alarm, the parents awoke to the sound of the alarm and then woke the child. The child was then required to go to the bathroom, complete the void, change clothes, linens, and complete a datasheet. Here the procedures of cleanliness training were also utilized. The second child shared a bedroom with the first child and so observed treatment and some reduction in the frequency of bed-wetting was observed from this. Use of the alarm, and cleanliness procedures were then introduced for the second child and both children achieved the success criterion of 14 dry nights. Treatment gains were maintained at a 10 month follow-up.

*Nocturnal enuresis: Group Designs*

Mowrer (1938) and Mower and Mower (1938) first introduced the urine alarm as a treatment for nocturnal enuresis and reported a 100% success rate at \_\_ months follow-up for 30 participants. Since then a number of random controlled trails have been conducted to assess the effectiveness of this treatment and the results for the alarm treated groups are described below. The control groups received a variety of treatments including drug treatments, psychotherapy, wakening, whereas others were simply kept on a waitlist. All of these studies showed that treatment with the urine alarm was better than treatment by the control condition, and this finding was shown to be statistically significant.

Young and Turner (1965) treated 105 patients with the urine alarm and reported that 65% of these participants showed an initial arrest of nocturnal enuresis, with 13% of these relapsing at 6 and 12 month follow-up. Their criteria for success was 14 consecutive dry nights and treatment took an average of 2.2 months. Similarly, DeLeon and Mandell (1966), reported successful treatment of 79% of their 56 participants suffering from nocturnal enuresis, with a similar criterion of 14 dry nights. These authors report that 79% of those individuals had relapsed at a 6 month follow-up. Novick (1966) treated 36 individuals with the urine alarm and reported 89% success with a criterion of 14 nights of no wetting, and a relapse rate of 50%. Baker (1969) successfully treated 27 individuals using the standard urine alarm, using a success criterion of 28 consecutive dry nights, and reported relapse in 20% of these individuals. Forsythe and Redmond (1970) successfully treated 66% of the 200 individuals in their study; with 23% of this 66% having relapsed at the 12 and 36 month follow-up.

Butler and Robinson (2002) reported on an interesting application of the alarm to 66 children with nocturnal enuresis. They achieved a 54.5 % successful elimination of wet beds (14 consecutive nights dry) but also noted that 80% of these successful children slept through the en tire night; introducing a result that is not commonly found and which draws into question the underlying effective ingredient of the alarm method. These studies are summarized in figure 1.

Ikeda, Koga and Minami (2006) conducted an analysis of the treatment outcomes for 38 successfully treated enuretics (achieving 3 weeks of no wet nights) and 19 unsuccessful cases. Although the purpose of their study was isolation of variables in successful versus unsuccessful cases to support an active avoidance mechanism for the dry alarm method, their 66% success rate was accompanied by no significant differences in their participants in wet nights at baseline, age, and length of participation.

More recently Cutting, Pallant and Cutting (2007) reported on one of the largest (522) groups of children treated with alarms alone for monosymptomatic enuresis. There report was based on 505 of 849 enuretic children seen over a five year period and included a 6 month 24 month follow-up with 99% response rates . A total of 79.0% achieved initial dryness within a median of 10 weeks. Of those achieving initial dryness 73.0% remained dry at 6-month follow-up and 64% had remained dry at 24 months with no gender differences. Nineteen per cent of children required more than 16 weeks management with 56% achieving dryness. More girls achieved dryness than boys and more quickly No difference in initial success was found with respect to severity of wetting, or age. Additionally, relapse rates were unrelated to gender, age, or initial severity.

*Nocturnal Enuresis: Meta-analyses and Systematic Reviews.*

Kristensen, and Jensen (2003) reported on a meta-analysis of 35 random control studies from Mower and Mower (1938) to 1996. This capitalized on a previous review of 34 of those studies by Forsyth and Butler (1989) and 237 patients treated by Jensen and Kristensen (1999; 2001a; 2001b). This meta analysis indicated an approximately 38% success rate over 4 studies conducted between 1989 and 1996 as opposed to a 98% success rate for 4 studies from 1938-1958 supporting a steady decline in the effectiveness of the urine alarm for nocturnal enuresis. The authors attributed this to the systematic changes in reporting practice and underestimation of the problem of relapse. The probability of the success of alarm treatment for nocturnal enuresis increased with the frequency of wet nights, confirming previous findings.

Butler and Gasson (2005) reported a systematic review of 38 articles from 1980-2002 involving at least 10 children and a stand alone alarm treatment. Success rates ranged from 30% to 87% (mean 64%) and were influenced by the type of enuresis, the treatment duration and the success criteria adopted. In a subset of 20 studies involving 721 children who were treated for at least 6 weeks, 467 (65%) achieved 14 consecutive dry nights with only the alarm treatment. Again a lack of standard inclusion criteria and definitions of success and relapse made conclusions on treatment effectiveness hard to make.

*Relapse Urine Alarm*

Issues of relapse have been extremely prevalent in the literature on treatments for enuresis, especially in group studies. One study by Sacks and DeLeon (1983) illustrates this problem well. Fifty-two participants with nocturnal enuresis were treated with the standard urine alarm and of the 44 (84.6% of the total) successful treatments, only 16 (30.8% of the total) remained continually dry throughout a 1 year follow up. Positive outcomes increased to 24 (46.2% of the total) with the addition of successful retrainings (for those with at least 1 wet night per week for 4 consecutive weeks) who were followed an additional 1 year. In other words, although most of the individuals in this study were initially successful in meeting the dryness criterion, less than one third remained dry.

 As mentioned previously, Turner, Young and Rachman (1970), demonstrated that relapse rates using the urine alarm were reduced when it was applied intermittently; however, treatment to criterion took many more sessions. Other studies have replicated this finding. For example, Finley, Besserman, Bennett, Clapp, and Finley (1973), reported the treatment of nocturnal enuresis with the urine alarm, on a continuous and intermittent schedule of application, with 90 and 80 % initial success rates, and 44% and 12 % relapse rates, respectively. Finley, Wansley and Blenkarn (1977), treated 80 children using the urine alarm on a 70% schedule of application and reported a 94% success rate, with treatment taking longer than the average reported in the literature for 100% schedules, but relapse rates lower than typically reported for 100% schedules, at a statistically significant level. Taylor and Turner (1975) reported similar findings treating 61 children, divided into three groups; continuous application of the urine alarm, intermittent application of the urine alarm, and overlearining with the urine alarm. These authors reported 69% relapse on a continuous schedule of application, and a 44% relapse rate on an intermittent schedule of application. Furthermore, Taylor and Turner examined the effects of overlearning on relapse and found that this reduced relapse further to only 23%. Overlearning involves increasing fluid intake before bedtime and continuing treatment until a given criterion is achieved with a given fluid intake. Overlearning appears to be more effective in reducing relapse rates, with intermittent application being the next most effective compared to continuous application. It should also be noted, that mean treatment was longest (113.55days) with intermittent application, followed by overlearning (86.54 days) and shortest for continuous application (68.46 days) of the urine alarm.

 Morgan (1978) reviewed the literature reporting the effects of intermittent application and overlearning on the relapse rates of alarm treatment. Although both have consistently been shown to reduce relapse, overlearning was reliably found to be the most effective method of countering relapse using urine alarm treatment; however, studies have varied widely on their definition of relapse with some describing significant relapse as a return to pre-treatment levels of wetting, and others describing it as one incidence of wetting. This makes such reviews and analyses of the effects of treatment variations on relapse difficult.

*Summary of Urine Alarm Treatments*Many research studies have examined the effectiveness of the urine alarm since it was first used in 1938 . Although a few of these have examined the use of the urine alarm for diurinal enuresis, the majority of these studies have examined its utility in treating nocturnal enuresis. The reasons for this may be that many more approaches are available for use in diurnal enuresis where the individual is awake, but also that the use of an alarm in daily social situations could be particularly aversive for the individual, and may even result in a number of additional problems and side effects resulting from the treatment itself. There is support for the position that the effective process in treating enuresis is active avoidance of the general nusance associated with it. That is, the alarm may function simply as the occasion for operant learning involving positive practice, response cost, social disapproval, etc. This position is also supported by eveidence that any awakening system using these additional procedures is associated with success.

In 1977, Doleys provided a review of the literature to that point and concluded that, using each researcher’s criterion for successful treatment, bed-wetting was arrested in 75% of individuals. The duration of treatment raged from 5 weeks to 12 weeks with relapse rate of 41%, most of these occurring within 6 months of treatment. From those studies presenting data on re-treatment, approximately 68% were successfully retreated. Although other meta-analyses of urine alarm treatments around the same time reported higher success rates of 80-90% (Lovibond, 1964; Taylor, 1970), all data support the overall conclusion that initial success rates using the urine alarm are high, the relapse rates continue to be high, and variations such as overlearning and intermittent application should be incorporated into treatment to reduce these. In addition, the frequent reporting of ulcers associated with use of the alarm (Doleys, 1977) suggest that procedures requiring as few exposures as possible may be desirable.

 More recently, Glazener and Evans (2002) reported that children given alarms as part of a treatment package were 13 times more likely to become dry as children treated without alarms and that somewhere between 29% and 69% of children relapse after initially successful treatment. Moreover, attrition rates may be as high as 26% using alarm treatments, although Glazener and Evans state that this is not significantly different to attrition rates for other treatments of nocturnal enuresis. Nevertheless, we would argue that such attrition rates are problematic and should be addressed in future research. Ruckstul (2003) attempted to address this by examining the social validity of alarm treatments for 32 participants and their parents. Results suggested that the treatment was socially acceptable to the individuals surveyed, however, it should be noted that only 19 of the 32 participants initially involved actually completed the study.

 Despite the high attrition and relapse rates, Butler, et al. (2005) reported that enuresis alarms were used by 19.2% of parents surveyed on treatments used to treat their enuretic children. This was less common than restricting fluid intake in the evening and waking schedules, but more common than medications.

 Collectively these data make it clear that the urine alarm is an evidence-based practice for the treatment of nocturnal enuresis; however it is not successful for everyone, and relapse rates are high. Further, the use of intermittent schedules and overlearning are also evidence-based practices that enhance the efficacy of the alarm. However, there is much less evidence for use of the alarm for treatment of diurnal enuresis

Given these general findings and issues in the use of the urine alarm, procedures such as retention control training, waking schedules, positive practice, responsibility or cleanliness training and stream interruption exercises, continue to be investigated as stand alone treatments or components of a treatment package, and are discussed below.

Evidence for Retention Control Training

*RCT for Diurnal Enuresis*.

 Although many treatments using RCT for nocturnal enuresis have conducted RCT during the day, few have examined its effectiveness with diurnal enuresis. Fielding (1980) examined the RCTin group of 45 nocturnal enuretic children, and a group of 30 nocturnal and diurnal enuretic children, exposed to either urine alarm procedures, or RCT. As discussed previously, results suggest that alarm procedures were far superior to RCT and the RCT groups were subsequently exposed to alarm treatment; however, although there were some slight reductions in the frequency of day wetting under both treatments, this failed to reach statistically significant levels. Mean Bladder Capacities increased significantly for day and night-wetters who became dry by the end of treatment (both alarm only and RCT plus alarm), but not for those who did not become dry by the end of treatment. This study showed that RCT did not produce significant improvement for nocturnal enuresis, or diurnal and nocturnal enuresis.

*Single Subject Research on RCT*

Kimmel and Kimmel (1970) applied RCT to three individuals with nocturnal enuresis, increasing fluid intake, and increasing the retention interval gradually until it reached 30 minutes. Reinforcement was provided at the end of the required retention interval. All three participants became dry by the end of treatment, which lasted just 7 days for two of the participants, and 14 days for the other participant. All were still dry at a12-month follow up. Steadman (1972) conducted a variation on RCT by teaching one individual to discriminate bladder distention and to chart their own data on the number of nighttime wets. This treatment took 14 weeks; however, some relapse had occurred at the 3-month follow up. Miller (1973) examined the utility of RCT for two individuals suffering from nocturnal enuresis. The study involved two children suffering from nocturnal enuresis and the numbers of wet nights, as well as the frequency of diurnal voiding, were taken as dependent measures. No tangible reinforcers were provided and RCT was examined using a standard ABAB reversal design. The children charted their own data and were treated for 14 – 16 weeks, when both participants met the success criterion for dryness. At 4 and 7-month follow up, neither had relapsed. Doleys and Wells (1975) treated one individual using RCT as part of a package involving forced increase in fluid intake, a waking schedule, and reinforcement for voiding appropriately. Again the mean amount voided at each occurrence during the day was taken as a dependent measure, in addition to the number of dry nights. The individual was dry after 50 days of treatment and remained dry at a 14-week follow up.

In general single subject analyses of the effects of RCT typically take a long time and often involve additional procedures such as reinforcement. Although the reinforcement is programmed to follow the retention interval it also directly correlates with appropriate voiding and so it is possible that many successful applications could be due to the reinforcement of appropriate voiding and not the RCT itself.

*Group Research on RCT*

Starfield and Mellits (1968), investigated the effects of RCT with 83 individuals with nocturnal enuresis. Parents were instructed to allow free access to fluids throughout the day and to ask the children to withhold urination until it caused minimal discomfort. Pre- and post-treatment measures of bladder capacity and bed-wetting were taken, and the change in bladder capacity for successfully treated and unsuccessfully treated individuals was significantly different.

 Paschalis, et al., (1972), trained diurnal retention of urine for 31 individuals diagnosed with nocturnal enuresis. This training continued until the individuals could retain urine for 45 minutes before voiding, and took an average of 20 days. Enuretic participants were divided into two treatment groups; one group receiving treatment immediately after the collection of baseline data, the second receiving treatment after a period of no treatment, and a third group of non-enuretic participants whose data were also analyzed for differences in mean number of voids per day. Fifteen of the treated individuals were nocturnally dry, another 8 showed significant improvements, and the remainder showed no effect suggesting that RCT conducted during the day may have some inconsistent effect on nocturnal enuresis but the results are inconclusive.

 Harris and Purohit (1977) compared the effects of RCT with a no-treatment control group with 18 enuretic children. Results showed a significant increase in bladder capacity for the treatment group over the control group but that the frequency of bedwetting did not change significantly for the treatment group suggesting that while RCT may increase functional bladder capacity, this increase may not necessary change the incidents of bed wetting for individuals with nocturnal enuresis.

*Summary*

 In general, the use of RCT as a stand-alone treatment has been inconsistent in its effectiveness. Although evidence based criteria for number of studies and participants have been met, variations in procedures, the absence of substantial follow up data, and the lack of evidence for a causal relation between functional bladder capacity and enuresis, make evaluation difficult*; however*, RCT has frequently been included as a component of larger treatment packages discussed later.

Evidence for Reinforcement-Based Procedures

Few studies have examined the effectiveness of reinforcement- based procedures alone. Historically, these have utilized both positive and aversive contingencies, although most recent applications emphasize the use of positive reinforcement. Although reinforcement procedures have been used in conjunction with a variety of other procedures, only those primarily focused on the isolated use of reinforcement procedures will be described here. These studies have typically been conducted using a single subject design and have targeted cases of nocturnal enuresis.

Several independent studies have shown that reinforcement of appropriate behavior can result in acquisition of continence. For example, Nordquist (1971) used time out from positive reinforcement and differential reinforcement of appropriate behavior to reduce tantruming and other non-compliant behaviors. The hypothesis was that the child’s wetting was part of the same response class as the other targeted behaviors. This involved one child, and was conducted using a reversal design where the treatment was implemented, removed and then re-implemented. Procedures reduced both the targeted responses and incidents of wetting, with treatment taking 20 weeks to reach complete elimination of enuresis. The child was still free from wetting accidents at the 16-month follow up.

Samaan (1972) examined the effects of reinforcement for urination in the toilet, for a child with nocturnal enuresis. The child was also exposed to a waking schedule where she was wakened every 2-3 hours and guided to the bathroom to sit on the toilet. If she urinated while on the toilet she was given a piece of chocolate and a hug. After only 10 days of treatment, the child began to waken independently to urinate. Throughout treatment the schedule of reinforcement and the waking schedule were gradually faded. The participant remained dry at the 2 year follow up. Popler (1976) investigated the use of a token economy for non-enuretic behaviors with one individual diagnosed with nocturnal enuresis. The individual was instructed to record whether he was wet or dry each night, and during treatment he had a weekly meeting where records were discussed and verified, and one token was given for each dry night. The individual kept a graph of data posted on the meeting room wall, and was give $5 for every 15 tokens collected. The frequency of bed-wetting reduced to zero after 28 weeks of treatment and this had maintained by the 6-month follow up. Allgeier (1976) investigated the effects of modeling and reinforcement on the enuretic behaviors of two sisters both diagnosed with nocturnal enuresis. Both individuals were required to fill out a chart in the kitchen of their home indicating whether or not they had remained dry the night before, and were penalized some of their allowance for not reporting their data and for reporting inaccurately. During baseline, no additional contingencies were programmed for bed-wetting. When accurate reporting had been established, treatment began by consequating bed-wetting with a restriction on nighttime fluid intake. They were not aloud any liquid intake after 6pm until they had been continent for 21 days. Some reduction in the frequency of bed-wetting was observed after the implementation of the self-monitoring system, and both individuals became dry and remained dry for 44 and 65 days by the end of the study. No follow up data was reported. More recently, Hagopian, Fisher, Piazza, and Wierzbicki (1993) examined the effectiveness of a continuous schedule of reinforcement for continent urinations of one individual with diurnal enuresis. In addition, minimal attention was given following accidents, the child was taken to the bathroom every 30 min and directed to sit on the toilet while lukewarm water was poured over the genital area to increase the likelihood of urination. Accidents were reduced and continent urination increase from 17% to 84%. The treatment was implemented in an additive manner and these results were obtained using all elements described above. No follow up data were available.

Only one study used a punishment approach. Tough, Hawkins, MacArthur and Ravensway (1971) provided contingent punishment in the form of a cool bath for incidents of bed-wetting. Two individuals were involved in this study that lasted for 22 and 28 days until both became dry at night; however, one had relapsed at the 18-month follow up.

In general reinforcement based procedures alone can be effective in eliminating enuresis but may require extended periods of treatment in order to have such an effect. Having said this, the available data suggest that relapse rates may be fairly low with this type of treatment. Many studies utilizing reinforcement procedure have also used other components of treatment. Currently it appears that neither the volume of studies or participants meet the requirements for evidence based practice and the limited numbers of studies on the effectiveness of these procedures alone make further conclusions difficult and tentative. This also makes this area of research important and necessary.

Evidence of Effectiveness of Dry-Bed Training

Many of the treatments described so far have been utilized as part of a treatment package referred to as Dry-Bed Training (DBT). This was first examined by Azrin, et al., (1974) and has since been investigated and utilized by many researchers, exclusively in the area of nocturnal enuresis. A few of the individual treatment approaches described at the beginning of this section have not been discussed with respect to their effectiveness, primarily because they are not typically used, or at least not reported, as stand-alone treatments and so will be discussed and evaluated in terms of their role in DBT. Treatments involving many of the components involved in DBT will also be discussed here.

*Single-subject Research DBT*

Browning (1967) implemented a treatment package similar to the one later described by Azrin et al (1974) as DBT. Browning treated one individual with nocturnal enuresis using the urine alarm, a wakening schedule, reinforcement for wakening and going to the bathroom, and required the individual to change bedding. The participant was dry by week 7 of treatment. Follow-up data was not reported.

 Singh, Phillips and Fischer (1976), used a procedure similar to DBT with the exception that positive practice and the urine alarm was excluded. Instead of the urine alarm, these authors used an alarm clock that woke the individual 2 hours after falling asleep and then progressively earlier. Upon waking to the alarm the individual had to go to the bathroom and sit on the toilet. If accidents occurred she was required to change bedding, and praise was provided for dry nights. Although the nocturnal enuresis was eliminated using these operant procedures without the use of the urine alarm, it took 15 months for treatment to be effective; however, treatment effects had maintained at an 8 month follow up.

 Lassen and Fluet (1979) used DBT to treat the nocturnal enuresis of a 10-year old child, including use of a urine alarm, a requirement to get up wash face, void in toilet, wake parents, change bed, and reset alarm. An overlearning procedure was also added, possibly to reduce relapse, and involved an increased fluid intake before bed. Parents were trained to implement this procedure and conducted the treatment. Nocturnal enuresis was eliminated after 13 weeks, and treatment was terminated after 30 consecutive dry nights. Parent reported that effects were maintained at follow up although the time to follow-up was not reported by the authors.

 Papworth (1989) used DBT to treat a 42-year old male with nocturnal enuresis. The treatment involved RCT, scheduled awakenings, a urine alarm, cleanliness training, positive practice and reinforcement for dry nights. Enuresis was successfully treated after only 4-weeks of treatment and the individual had remained dry by a 6-month follow up.

More recently LeBlanc, et al., (2005) used a DBT-type package to treat diurnal and nocturnal incontinence in three individuals using a non concurrent multiple baseline intervention strategy. This consisted of a treatment package including a urine alarm, schedule for sitting on the toilet, reinforcement of successful voids and self-initiations, increased fluid intake, communication training and positive practice. Incontinence was eliminated for 2 of the three individuals and accidents were reduced for the third.

*Group Design Research on DBT*

Azrin, et al. (1974) were the first to describe and investigate the treatment package known as DBT. They examined the treatment of 24 individuals who were randomly assigned to 4 groups. One group received standard urine alarm procedures, another group received DBT where only the child heard the urine alarm, a third group received DBT where only the parents heard the alarm, and the last group received DBT where both parent and child heard the alarm. The DBT consisted of increased fluid intake, hourly awakenings, teaching child to awaken to a signal by sitting the child up or gently shaking them, positive practice of waking and going to toilet, reinforcement for urinating in the toilet at night, a urine alarm, training in awareness of the dry vs. wet condition of the bed, and cleanliness training. Successful treatment was reported for all 24 participants and was fairly rapid, with the average participant having only two wet nights before the success criterion of 2 consecutive dry weeks, was achieved. No major relapses are reported and no intensive retraining was required by the 6-month follow up.

Bollard (1977) examined the effectiveness of parent administered DBT on the nocturnal enuresis of 34 children. One group of participants used parent administered DB**T** and the other had parent administered DBT without the use of the alarm. Enuresis was eliminated for all children exposed to parent administered DBT using the alarm and took only 12 days, with only two relapses. Although reductions were achieved, in the group exposed to DBT without the alarm, enuresis was not completely eliminated for any of the children. The authors suggest that the use of the alarm with other procedures imply allows for the more immediate and effective application of relevant consequences.

Keating, Burke and Heimberg (1983) further investigated the necessity of an alarm in DBT, and the effects of training parents to implement treatment. Twenty-three individuals were divided into three treatment groups that varied on the training setting (home or office) and whether training was conducted with the parent and child or just the parent. Seven individuals on a waitlist were monitored. Although the treatment groups did improve compared to the waitlist group, enuresis was not successfully eliminated for any of the participants. Furthermore, 6 of the 23 participants in the treatments groups dropped out of the study.

Bollard and Nettelbeck (1981) also investigated the level of supervision necessary for parents to effectively implement DBT and compared the effects of DBT to a standard alarm procedure. In the first experiment they compared the application of standard urine alarm procedures implemented by parents who were closely supervised and parents who received no supervision after initial instructions. Parental supervision while implementing treatment with a urine alarm resulted in greater decreases in enuretic incidents. The second experiment compared DBT under four conditions: (a) by the child’s parents at home, (b) by a professional trainer at home, (c) by a professional trainer in hospital, and (d) by the child’s parents without use of an alarm. DBT was successful under all condition except where no buzzer was used, in which case it was only marginally more effective than no treatment at all. Furthermore, DBT was superior to standard urine alarm treatment.

Van Londen, Van Londen-Barentsen, Van Son, and Mulder (1995), investigated the effectiveness of bibliotherapueutic treatment by parents, allowing them to act as therapists for their child’s nocturnal enuresis. Parents were given a set of instructions and a urine alarm. One group were instructed to give or remove stickers immediately after the child’s alarm goes off, they wake to urinate, or their bed is dry in the morning. A second group was given instructions to apply consequences only the next morning, and a third group used only the alarm and were not given instructions to provide specific programmed consequences. Ninety-sever per cent of group 1 was successfully treated to eliminate nocturnal enuresis, with only 84% for group 2, and 72% of group 3. At a 2 ½ year follow up maintenance of results were reduced to 92% for group 1, reduced to 77% for group 2, and stayed the same at 72% for group 3. Again the authors suggest that the increased success using the urine alarm is simply that it allows for the more immediately application of consequences for wetting.

*Summary of DBT*

DBT was originally shown by Azrin et al (1974) to be very effective and efficient in arresting nocturnal enuresis. Since then other studies have not had quite the same degree of success but have demonstrated that it is an effective and rapid method for treating and often eliminating enuresis. The literature indicates that DBT meets the requirements for evidence based treatment with the alarm, and may be effective alone as long as the enuretic is awakened. Studies investigating the use of parents as therapists not only increase the accessibility to treatment but make it more cost effective as it is often difficult to find a professional willing to conduct all night intensive treatment and the cost of that can be high. Given this it is important to simplify procedures as much as possible without losing the effectiveness of the treatment.

The literature on DBT suggests that some components may be necessary while other may be less critical to the success of treatment. The use of a urine alarm in DBT has been repeatedly shown to be critical. The role of the alarm in DBT seems to be to provide the opportunity to implement other contingencies and elements of the treatment package. Consistent with studies on the use of the urine alarm, overlearning has been shown to be a useful addition to treatment packages as it reduces the likelihood of future relapse. Further, a waking schedule, or reinforcement for waking to minimal prompts, has been shown to be relevant to treatment success, as well as some procedure by which to ensure that the child is fully awake. This could be served by washing their face, showering, or by completing a task that is effortful and requires wakening such as changing bedding.

Alternatively the literature suggests that some elements are not necessary for treatment success. RCT appears to be less relevant to success and does not consistently show increased continence either alone or as part of a treatment package such as DBT. Other elements, such as positive practice, require further research to determine the role they play. Other treatments such as Kegel exercises have often been added to treatment packages (Friman & Jones, 1998) but have not been evaluated and thus remain non-evidence based practice. Tarbox, Williams & Friman (2004) also suggest that the wearing of diapers should be considered as an important variable when considering treatment for continence issues, although further research is also required on this issue.

Overview of Research on Behavioral Treatments

 Urine alarms, although often effective, are also associated with frequent relapse. Relapse can be reduced by the addition of procedures such as overlearning and intermittent schedules. The addition of reinforcement for appropriate behaviors and other contingencies such as those described in Dry-Bed Training provide a treatment that is consistently effective in a short period of time with few relapses. Parents, given some minimal level of instruction and supervision, can effectively implement DBT.

 Evaluation and comparison of treatment approaches and success rates in the treatment of enuresis is made difficult by variability surrounding treatment success criteria. Research has varied widely on definitions of successful treatment of enuresis with some only requiring an improvement from baseline and others requiring 14 consecutive days of dryness. Given this success in one study may not be considered as success in another study. Furthermore, relapse has suffered the same fate. Some studies have considered relapse to be one incidence of wetting, with others not considering relapse to occur unless wetting has returned to baseline levels. This also raises the variability of follow-up periods, as follow-up data cannot be collected until a minimal period of dryness, considered as successful treatment in the original criterion, has passed. If a follow up period is extremely short, then relapse by any criteria is less likely and an extremely long follow up period may be considered somewhat unethical given that there is often a social stigma associated with problems of continence. Moreover, clarity in these areas may make more clear a reasonable treatment time that should elapse before it is considered as a failure to treat and other methods are considered. A resolution of these issues may make conclusions regarding effective treatment stronger than the current analysis.

OTHER TREATMENT APPROACHES

 A recent Cochrane review provides a summary of several alternative approaches and the state of our knowledge regarding their effectiveness. Glazener, Evans, & Cheuk (2008) conducted this meta analysis. They reviewed 15 randomized trials describing a variety of treatment approaches and concluded that the studies provided weak evidence to support the use of hypnosis, psychotherapy, acupuncture and chiropractic. However, the studies in general were small, and of weak methodological caliber.

EVIDENCE-BASED PRACTICES FOR ENURESIS

Evidence based practices as reported in the Cochrane data base for enuresis suffer from a general lack of specific comparisons of treatments for differing types and classifications of enuresis as outlined at the beginning of this chapter. The most recent available papers published as 2008 updates earlier studies (Glazener & Evans 2002; 2004; Glazener, Evans, & Peto, 2000a, 2000b). In general these papers report that meta analyses are not available for complex treatments of enuresis that include alarms and other further interventions such as medications or DBT and conclusions that can only be drawn from small single subject trials indicate that alarm and other interventions such as DBT are more effective than alarm alone but that any treatment with alarms appears better than any treatment without alarms. For simple enuresis, outside of the known effect of desmopressin (while the drug is being taken) simple behavioural interventions may be effective for some children, but further comparison trials of components are needed. Simple methods could be tried as first line therapy before considering alarms and DBT types of procedures, because these later treatments may be more demanding and may provide increased opportunity for stress and inconsistency.

 The large-scale study by Cutting, et al. (2007) provides strong support for alarm treatment of monosymptomatic nocturnal enuresis albeit not shown in a randomized study. Indeed after 70 years since Mower first reported on the original alarm treatment it is the need for randomized controlled studies of combination treatments that is still needed.

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|  |  |  |  |
| --- | --- | --- | --- |
| Author(s)  | Participants | Initial Success Rate | Rate at Follow- Up  |
| Mower & Mower 1938 | 30 | 100%\*  | 100%  |
| Young & Turner, 1965 | 105 | 65% \* | 55% at 12 months |
| DeLeon & Mandell, 1966 | 56 | 79%\* | 16% at 6 months |
| Novick, 1966 | 36 | 89%\* | 50% 8-12 months  |
| Baker, 1969 | 27 | 100%+ | 80% at 6 months |
| Forsythe & Redmond, 1970 | 200 | 66%\* | 43% at 36 months |
| Butler & Robinson, 2002 | 66 | 54.5%\* | Not reported |
| Cutting, Pallant & Cutting, 2007 | 522 | 79%\* | 64% at 24 months |
|  |  |  |  |

\*=14 consecutive nights dry; + = 28 consecutive dry nights

Figure 1. Example outcomes of group studies using the wet bed alarm for nocturnal enuresis

Figure 2. A summary of the evidence for effectiveness of the different Enuresis treatments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Treatment**  | **Strong Evidence**  | **Weak evidence** | **Needs more study** |
| **Pharmacological** | Imipramine |  | Y\* | Y |
|  | Desmopressin | Y\* |  |  |
|  | Oxybutinin |  | Y\* | Y |
| **Behavioral** | Alarm | Y |  | relapse |
|  | Dry Bed Train  | Y |  |  |
|  | Reinforcement |   | Y |  |
|  | Retention Training |  | Y | Y |
|  | Kegel exercises |  | Y | Y |
|  | Waking schedule |  | Y | Y |
|  | Positive practice |  | Y | Y |
| **Other** | Acupuncture |  |  | Y |
|  | Psychotherapy |  |  | Y |
|  | Hypnosis |  |  | Y |
|  | Chiropractic |  |  | Y |

\*= Only effective while the medication is being taken